Bell Telephone MAGAZINE

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Bell Telephone Magazine

A non-technical review, published quarterly to give Bell System management people a broader view of the history, objectives, operations, and achievements of this business than they might attain in the course of their day-to-day occupations, and an added sense of participation in the problems and accomplishments of our nation-wide public service.

A MEDIUM OF SUGGESTION and A RECORD OF PROGRESS

Cover: Submarine Telephone Cable Splice at Sea. Painted for this Magazine.
George Samerjan

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JUDSON S. BRADLEY, *Editor* SALVATORE J. TAIBBI, *Art Editor*

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CLEO F. CRAIG, *President* S. WHITNEY LANDON, *Secretary* JOHN J. SCANLON, *Treasurer*

Who's Who & What's What

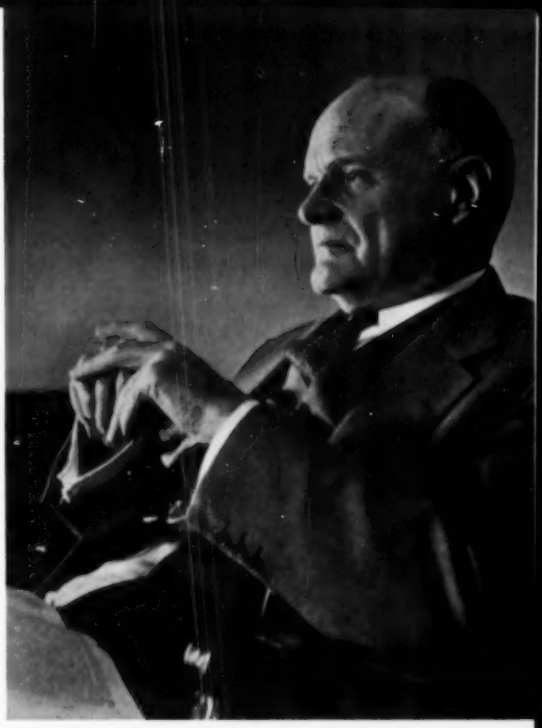
IN THIS ISSUE

"INTERNATIONAL COMMUTER" might be an apt if somewhat dramatic way of describing C. C. DUNCAN in recent months; for his duties anent the transatlantic cable have taken him many times, and often at short notice, to England and to several parts of Canada—as well as to the Mediterranean and the eastern Atlantic for last Spring's tests. More than 25 years—including eight months in the Department of Operation and Engineering of the A. T. & T. Co.—have prepared him to assume the responsibility for building the Bell System's share of the greatest overseas communications enterprise of the century. Joining Long Lines in St. Louis in 1927, he went to Dallas in 1939 as district plant superintendent. In 1945 he returned to St. Louis, where he became division plant superintendent. In 1950 he went to New York as general plant supervisor, and soon was appointed assistant to the general manager. His eight months with O. & E. were as supply practices engineer in 1951—and it was during this period that he contributed "Conservation of Materials" to this MAGAZINE for Autumn 1951. He then returned to Long Lines as operating staff manager. In November 1953 he was appointed general manager-special projects: a synonym, let us say, for embodying in reality the great vision of the transatlantic cable—and for others too, such as the Seattle-Ketchikan cable, which is on the agenda.

IF THE DISTILLATE of sound judgment and broad experience is wisdom, then the wise words of T. BROOKE PRICE in this issue should be thought-provoking to many in and outside of Bell System legal departments. Mr. Price entered the Bell System employment in 1934, and two years later became vice president and general coun-

C. C. Duncan

sel of the Western Electric Company; but he had been practicing law since 1915 and had been for many years a member of a legal firm which the A. T. & T. Co. had consulted upon occasion for 10 years before his election. He moved from Western Electric to become A. T. & T. general attorney in 1941, and ten years later Mr. Price was made vice president and general counsel.



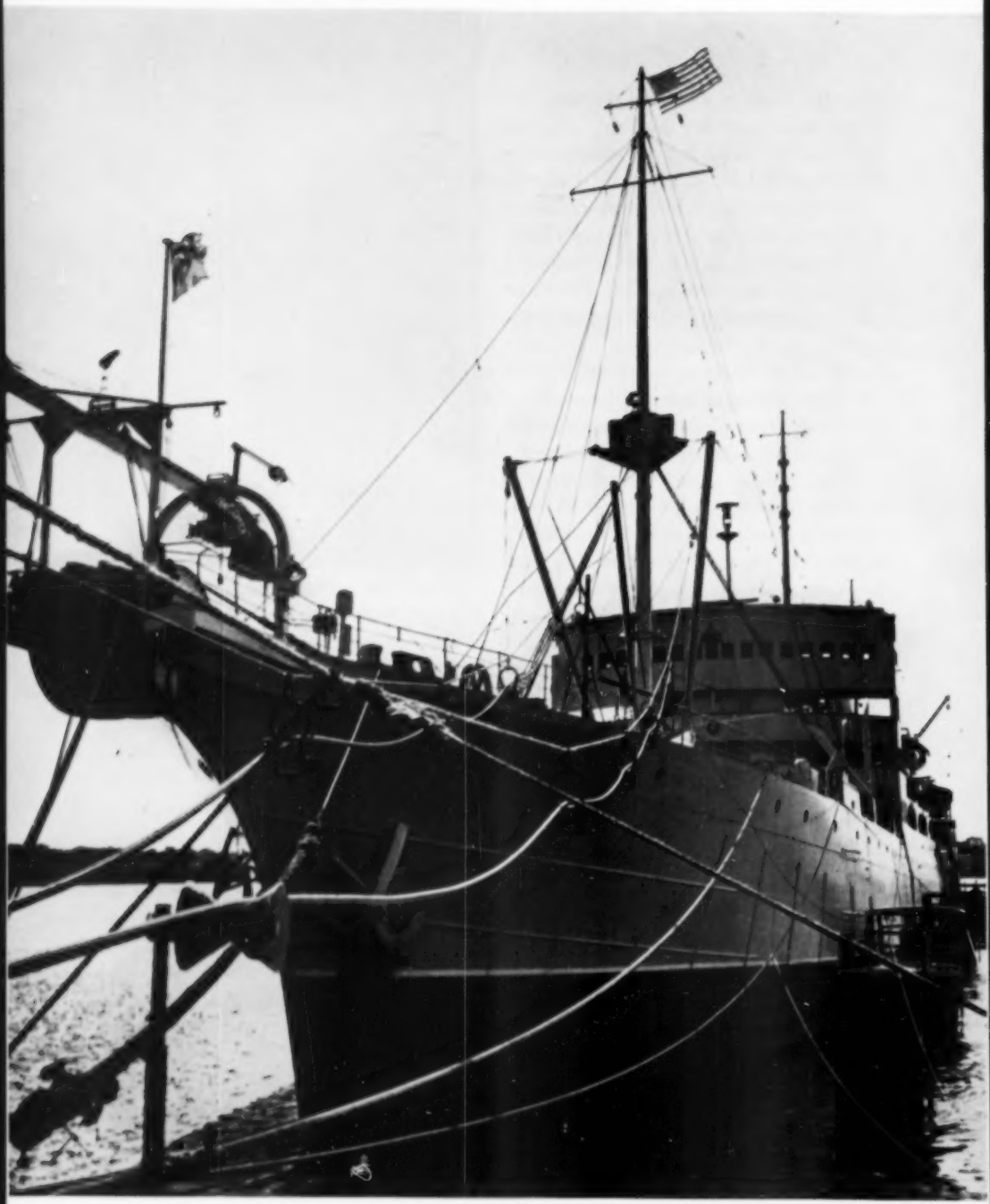
T. Brooke Price

PLANT SALES ENGINEER since the first of this year, RUDOLPH EKLUND has a wide background of plant experience: wide enough to include service in Minnesota, Missouri, Arkansas and Texas with the Southwestern and Northwestern Bell Telephone Companies. He came to A. T. & T.'s O. and E. Department in May of 1954 from the Kansas Area of Southwestern, where he had been general plant manager. Until his present appointment to coördinate plant merchandising activities, he had been rural service engineer, and he will continue to assist the operating companies in improving and extending rural telephone service.

Rudolph Eklund

THE PACIFIC COAST is home territory to ROBERT G. ELLIOTT, who broke away from it only last year to become assistant chief engineer in the O. & E. Department of the A. T. & T. Co. With the Pacific Telephone and Telegraph Company since 1928, he started as a student in Seattle and held various plant and engineering jobs in the Washington-Idaho Area until 1947, when he became plant extension engineer there. In 1950 he moved to San Francisco as general program engineer, and in 1951 he became plant extension engineer of the Southern California Area. Two years later he was made chief engineer there—which was the post he left to make the long stride to New York.

(Continued on page 140)



Cable goes aboard H. M. T. S. MONARCH *at the Simplex Wire and Cable Company plant at Portsmouth, N. H.*

This century's greatest overseas communications enterprise has international flavor as Great Britain, Canada, and the United States coöperate in vast undertaking

TRANSATLANTIC TELEPHONE CABLE PUTS OUT TO SEA

C. C. DUNCAN

General Manager, Special Projects, LONG LINES DEPARTMENT, A. T. & T. CO.

EARLY ON THE MORNING of last June 28 the cable ship *Monarch* slowly steamed through the Northwest arm of Trinity Bay, leaving behind the village of Clarenville, Newfoundland. Nevertheless, she was still connected with the new cable station at Clarenville—by the cable being payed out at increasing speed as she steamed into the Atlantic.

Cable ships have been terminating transatlantic cables in Trinity Bay for almost a hundred years, ever since the "Great Eastern" laid the first successful transatlantic *telegraph* cable; but this new cable was different. For it was the first transatlantic *telephone* cable. When it is completed, speech will be transmitted across the Atlantic by cable for the first time. So this was a big day for telephone people on both sides of the Atlantic. They had dreamed about such a development since the telephone was invented, and for more than 30 years have actually worked towards this modern miracle of communication.

The conception of this daring project originated with Dr. Oliver E. Buckley, President of the Bell Telephone Laboratories from 1940 to 1951, who in 1919 headed a small group investigating problems of deep-water cable technology. At first they worked on short lengths of telephone cables in medium depths of water, but ultimately they learned more and more about what was involved in bridging vast expanses of deep water. As the study progressed, a whole new technology was brought to the fore while an array of synthetic and natural conducting, insulating, and protective materials was examined. By the late 1920's plans were actually made for a cable across the North Atlantic, but various factors caused the project to be set aside. Nonetheless, Dr. Buckley kept a small force working against the day when this dream could be realized.

Meanwhile, in 1927 transatlantic telephone service was opened by employing radio circuits. Over the years it has in-

creased tremendously in scope and usage and has become an international success. However, this service has been subject to two important limitations: one, the crowded radio spectrum which limits the number of circuits that can be provided; the other, the periodic magnetic storms which impair the transmission of radio waves, particularly over the North Atlantic. During the past quarter century, for instance, three periods of severe atmospheric disturbance have affected the transatlantic service. (The most recent, which started in 1950, is subsiding.) Thus the shortage of radio frequencies and the magnetic storms affecting radio circuits have pointed to the need for a telephone cable to handle the growing volume of transatlantic telephone calls.

To solve the many problems that would be encountered in making such a cable system, Bell System engineers continued their search for techniques, apparatus, and material which would minimize the hazards of laying, operating, and maintaining a deep-sea telephone cable. This led to the design of an electronic vacuum tube that would survive on the ocean bottom for more than twenty years, terminal equipment to feed power out over the cable to these tubes, and the creation of an ingenious flexible amplifier or repeater that could be incorporated into the cable and laid as an integral part of the long underwater coaxial pathway. As the prototype of the transatlantic-cable-to-be, the cable laid in 1950 between Key West, Florida, and Havana, Cuba, embodied all these features, and its performance was followed with the greatest interest.

Such was the success of this cable that, early in 1952, President Cleo F. Craig of the American Telephone and Telegraph Company appointed a committee to report upon the feasibility of a transatlantic telephone cable. Its members were Vice President George L. Best, Chairman; Vice Presidents Frederick R. Kappel * and Henry T. Killingsworth of the A. T. and T. Company; and Dr. M. J. Kelly, President of the Bell Telephone Laboratories. (In January 1954 A. T. and T. Company Vice President Eugene J. McNeely became a member of the committee when he assumed charge of the Operation and Engineering Department.)

In reporting favorably on the project by May of 1952, the Committee suggested early discussions with officials of the British Post Office, which furnishes telephone service in the United Kingdom. The United States government officials who were consulted heartily endorsed the cable proposal.

The Project Gets Under Way

In August 1952, Mr. Best and William G. Thompson, Assistant Vice President of the A. T. and T. Company, went to London for a prearranged exploratory discussion with British Post Office officials. They were warmly received by Earl De La Warr, then Postmaster-General; Sir Alexander Little, Director General of the Post Office; Sir Ben Barnett, Deputy Director General; and their associates. The ensuing discussions served to lay a broad foundation for the project, which, it was learned, had for some time been in the minds of Lord De La Warr and other British Post Office officials. Dr. Kelly, who had been on the Continent, joined in these London talks before their conclusion.

In view of the favorable prospects afforded by these initial discussions, an approach was then made to the Canadian government, which welcomed the opportunity to participate in the venture. Follow-

* Now President of Western Electric Company.

President Cleo F. Craig of the A. T. and T. Company signs the agreement with Great Britain and Canada to launch the first transatlantic telephone cable. Looking on is Assistant Vice President William G. Thompson, who is also President of the Eastern Telephone and Telegraph Company —A. T. & T. subsidiary which will furnish the facilities passing through Canada.

ing an initial consideration by Lionel Chevrier, Minister of Transport, and J. C. Lessard, Deputy Minister, Canada was represented in subsequent negotiation by Douglas F. Bowie, President of the Canadian Overseas Telecommunication Corporation, the governmental agency for overseas communications.

The types of facilities to be used were left for the technical organizations of the British Post Office and the Bell Telephone Laboratories to consider and agree upon. During November and December, 1952, a committee headed by Dr. Kelly and Dr. W. G. Radley—then Engineer-in-Chief of the B. P. O. and now Sir Gordon Radley, Deputy Director General—studied these matters and made its recommendation. This report advised using a cable system of Bell Laboratories' design between Scotland and Newfoundland, and one of British design in the shallower waters between Newfoundland and Nova Scotia. A further recommendation proposed that the link between the United States and the Nova Scotia cable terminal be a radio relay system. These suggestions were subsequently concurred in by the Canadian participants.

During 1953 several meetings were held in London, New York, and Ottawa at which the British, Americans, and Canadians negotiated matters relating to ownership, manufacture, cable-laying, operation, and maintenance of the proposed cable system.

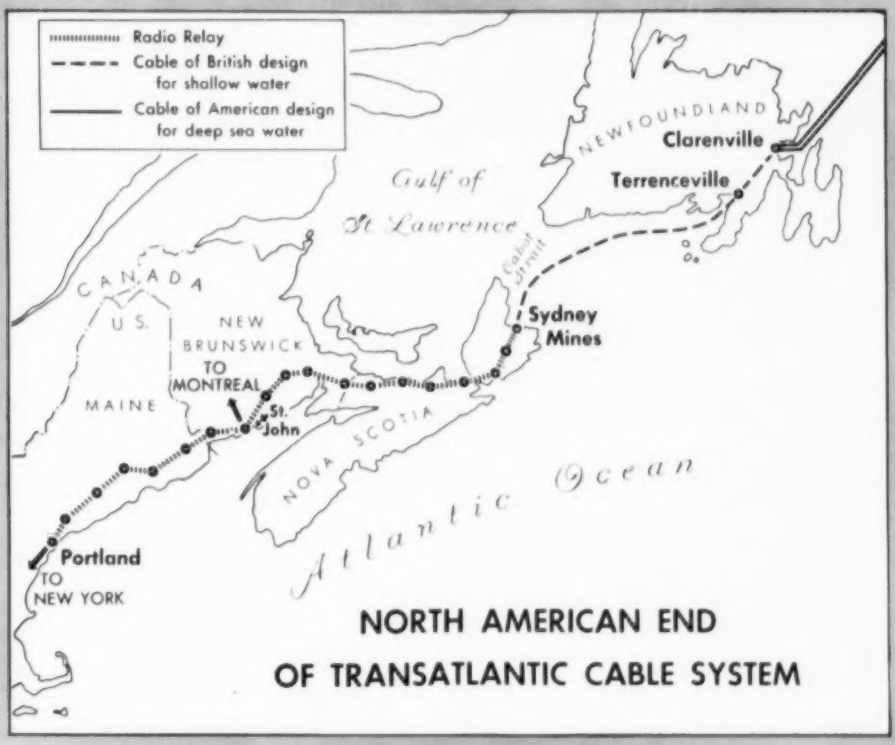
Signing the Contracts

Earl De La Warr, then British Post-Master General, signs the contract for Great Britain. From left to right are American Ambassador Winthrop Aldrich, Sir Clement Hallam, Solicitor to the General Post Office, Lord De La Warr, Frederick Hudd, Deputy High Commissioner for Canada, and, in the rear, Mrs. D. E. Mitchell.

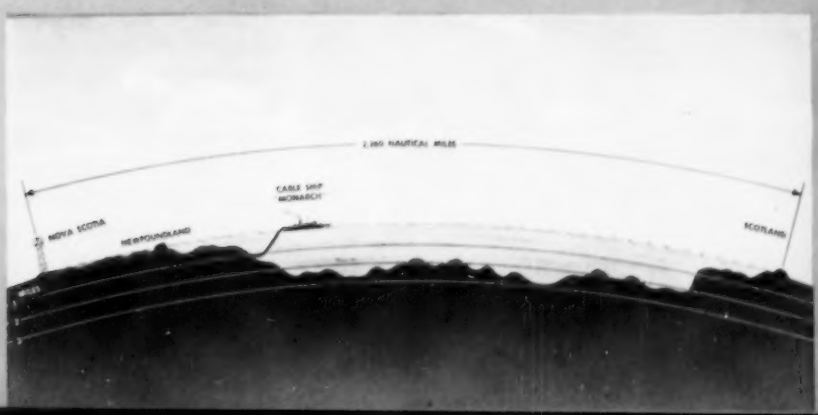
President Douglas F. Bowie of the Canadian Overseas Communication Corporation affixes his signature to the contract as Secretary-Treasurer R. J. Cassidy looks on.

C. C. Duncan, in his capacity as general manager of Eastern Telephone and Telegraph Company, contracts with Clifford W. Smith, sales manager of Western Electric, for equipment and materials. Standing are (l. to r.) Stimpson Hubbard, Western's commercial relations manager, J. Stirling Jack, manager of Eastern, and Norman R. Frame, Secretary of Western Electric.

Route of the transatlantic telephone cable system between Portland and Oban.



Profile of the ocean bottom on which the cable will rest.



The basic responsibilities and rights of each of the parties in the joint undertaking were finally set forth in a contract dated November 27, 1953.

The signing of this agreement involved an interesting procedure. The Privy Council of Canada approved the agreement in Montreal on November 26, 1953. In New York the following day officials of the A. T. and T. Company and the Eastern Telephone and Telegraph Company (a Canadian subsidiary of the A. T. and T. Company which will provide, own, and operate that Company's part of the cable system in Canadian territory), signed an original contract. At the same time, officials of the Canadian Overseas Telecommunication Corporation signed an original contract in Montreal, and in London the Postmaster General of Great Britain affixed his signature to another original.

The ceremony was not concluded until all four originals, carried by couriers flying between the three countries, had their full complement of signatures. This was completed by December 1, 1953, when public announcements were made about the cable project. With that event, task forces in three countries began turning the dream of yesterday into the actuality of tomorrow.

In essence, the international project thus set in motion involves two separate one-way cables, laid some 20 miles apart, between Oban, Scotland, and Clarenville, Newfoundland. They will have a capacity of 36 telephone channels. In each cable, voices traveling under the Atlantic for more than 1,900 nautical miles * will be sped on their way by 52 one-way repeaters. (Thus, there will be a total of 104 amplifiers in the transatlantic link.) In Scotland, connection will be made to London over the British long distance telephone trunk network.

At Clarenville, connections will be made to a British-designed two-way submarine cable extending 330 nautical miles to Sydney Mines, Nova Scotia. This cable will be equipped with 16 repeaters. For a few miles down the coast from Clarenville this section of the voiceway is under water. Then, as a land cable, it will go 50 miles overland across the rugged, rocky hills of Newfoundland, through swamps, lakes, and arms of the sea. Next, as a submarine cable again, it will enter the sea at Terrenceville, at the head of Fortune Bay, and cross the mouth of the St. Lawrence river, called Cabot Strait, between Newfoundland and Sydney Mines, Nova Scotia.

From Sydney Mines the telephone circuits will be carried 575 miles over a new radio relay system to Portland, Maine, where the United States circuits will be connected to the Bell System circuit network. The Canadian circuits will break out of the Sydney Mines-Portland radio relay system near St. John, New Brunswick, where connections will be made with facilities to Montreal.

Immediately after the signing of the agreement to build this cable, the British, Canadian, and American technical staffs started the first of a series of meetings to determine how to convert the over-all design into an operating system. They found that the job of combining the varying types of telephone plant of their individual countries into an integrated system involved many problems. They learned, for example, that some of the very words they had used all of their lives have different meanings in the different English-speaking countries. However, the good humor and spirit of coöperation which were keynotes of these

* A nautical mile is approximately 6080 feet.

and all subsequent meetings helped in solving the many difficulties involved.

What are some of the technical problems and achievements inherent in this undersea newcomer? The answer is found in considering several topics: Cable Manufacture . . . Repeaters . . . Power Equipment . . . Cable Laying . . . and the facilities involved in the 1000-mile approach on this side of the Atlantic. Let us consider them in order.

Cable Manufacture

AT PRESENT the longest deep-sea submarine telephone cable with repeaters is the Key West-Havana link, opened in 1950. About 125 miles long, it is laid in water about one mile deep and has a total of six submerged repeaters.

A submarine telephone cable in shallow water between Aberdeen, Scotland, and Bergen, Norway, was laid in October, 1954, by the British Post Office. About 300 miles long, it contains seven repeaters, and is laid in water less than one-quarter of a mile deep.

Thus a tremendous forward step is represented by the pair of telephone cables to be laid under the North Atlantic to depths of about two and one-half miles—cables about 1950 miles long and containing 52 repeaters each. While the design of this deep-sea cable is similar to that of the Key West-Havana cable, the greater length, greater depth of submersion, and larger number of telephone circuits to be derived requires the transatlantic cable to be manufactured to much closer tolerances than previously needed.

The central conductor of the transatlantic cable is made up of a solid wire over which three copper tapes are wrapped. A thick layer of crack-resistant polyethylene plastic insulation of a special type is extruded over this conductor. And to com-

Long-life vacuum tubes, demonstrated at the Bell Telephone Laboratories, are basic to the transatlantic telephone cable project.

At Bell Telephone Laboratories, specialists discuss tests on a laboratory model of one of the networks for the repeater.

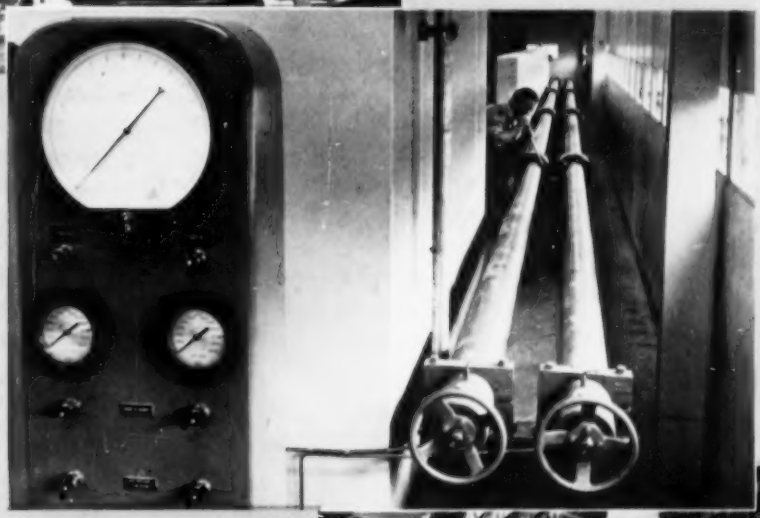
Here a laboratory model of the repeater is being tested. There will be 104 of these repeaters in the two one-way cables.

A perfect watertight joint in a section of the cable undergoes examination. Between Scotland and Newfoundland the cable will be laid at depths of up to 2½ miles.

At Western Electric's Hillside repeater shop, this area is slightly pressurized, to prevent the entrance of dust or lint.

An inspector scrutinizes a finished network section under a binocular microscope to detect even the most minute imperfections.

Below: Finished repeaters, with cable leads at each end, are tested at up to ocean pressures in these long cylinders.



Finished repeaters from the Hillside shop were flown to England—each protected in this odd-shaped case—for incorporation in the cable which was laid during last Spring's tests off Africa.

plete the electrical transmission path, a return conductor consisting of spiraling copper tapes is laid over the polyethylene core. Then comes a series of protection tapes—thin copper to guard against a marine worm called teredo, which is fond of eating cables; a fabric tape; a layer of jute; and then armor wires. These wires are themselves protected by a galvanized coating and a fabric cover of tape or braid impregnated with an asphalt compound. Finally, for additional protection, a double layer of jute covers the armor wires.

The amount of armor depends on the depth of water and possibilities of damage from ships' anchors, ice floes, etc. In the greatest depths, which range from one-half mile to two and one-half miles, steel armor wires of great strength are used to withstand the strain of laying or picking up the cable. Here it weighs one and one-half pounds per foot of length and is about one and one-quarter inches in diameter.

However, near the shore, where there is possibility of damage from ships' anchors, much heavier armor wire is used. In this section the diameter of the cable increases to almost two inches and its weight to about four pounds per foot.

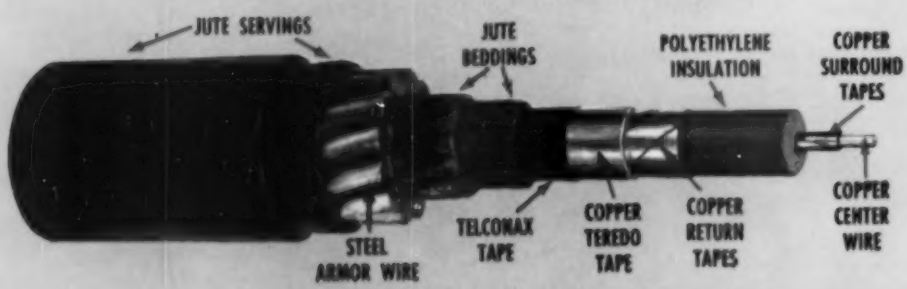
In a short section off the coast of Nova Scotia, where icebergs may ground on the cable, a second layer of heavy armor wire is added. This brings the diameter to about three inches and the weight to ten pounds per foot.

To many, it at first seems strange that the thinnest, lightest cable is used at great depths while the heavier armoring is needed near shore—but experience has shown that the greatest protection is needed in the shallowest water.

Although the design of this cable, particularly the armoring described above, is based on experience with deep-sea cables over many years, it is unique in many respects and requires new manufacturing techniques to meet the close tolerances required. New equipment developed to meet these exacting specifications includes an ingenious combination of a photoelectric cell, to measure the diameter of the polyethylene insulated cable core as it is extruded, and a "capacitance monitor" that continuously measures an electrical characteristic of the cable core as it is being made. An "electronic brain" takes these two factors into consideration and controls the speed of the extruder so as to make perfect core continuously.

Ever since it collaborated with the Western Electric Company to manufacture nine miles of submarine cable for use in Michigan 50 years ago, the Simplex Wire and Cable Company of Cambridge, Mass., and Portsmouth, N. H., has on occasion aided in Bell System projects. Simplex manufac-

Composition of the type of cable used in shallow water.



tured the deep-sea cable placed in 1950 between Key West and Havana. Simplex is also participating in this new undertaking by manufacturing that portion of the transatlantic cable produced on these shores.

On the other side of the Atlantic, these new ideas are being put into operation by the oldest submarine cable manufacturing company in the world. Submarine Cables, Ltd., whose forerunners made the first submarine cable over 100 years ago and the first transatlantic telegraph cables shortly thereafter, has manufactured most of the submarine cables in the world today. And with its large production capacity, it will manufacture most of the present transatlantic cable.

In the industrial village of Erith, not far down the Thames from London, a new plant has been built by Submarine Cables, Ltd., especially to manufacture its share of the transatlantic telephone cable. It is to this plant that the repeaters made in the United States by the Western Electric Company are flown, in specially constructed and cushioned aluminum cases, for insertion into the cable being made there. Here, as at Simplex's plant at Portsmouth, N. H., a team composed of British Post Office, Submarine Cables, and Bell System engineers and technicians is working to combine the new techniques with years of experience in cable-making.

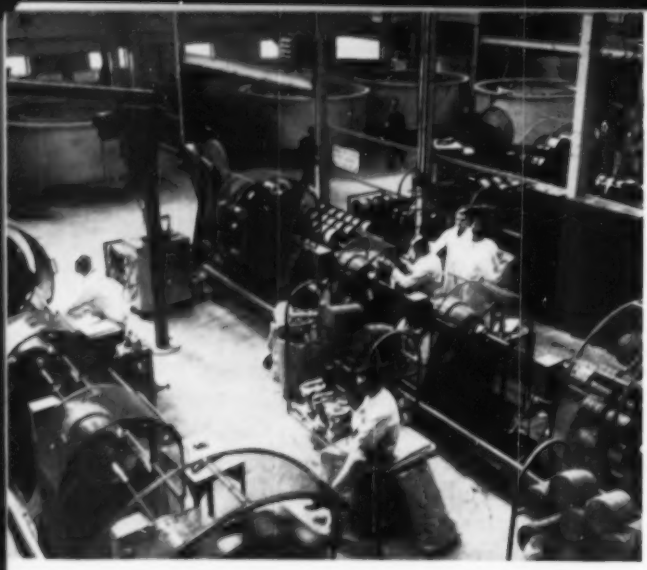
The Repeater

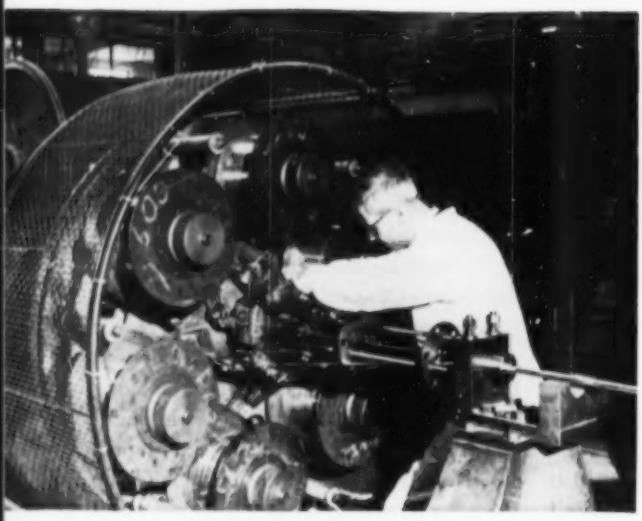
FOR MORE THAN fourteen years, engineers at the Bell Telephone Laboratories have made frequent checks upon a group of very specially designed electron tubes that have been operating continuously over that period. These tubes and their long performance are fundamental to the deep-sea portion of the transatlantic cable project. For because of their long survival, and Bell System experience with similar tubes in the waters between Florida and Cuba, it is confidently believed that tubes of like design in each of the repeaters will provide amplification over the Atlantic span for at least 20 years without attention.

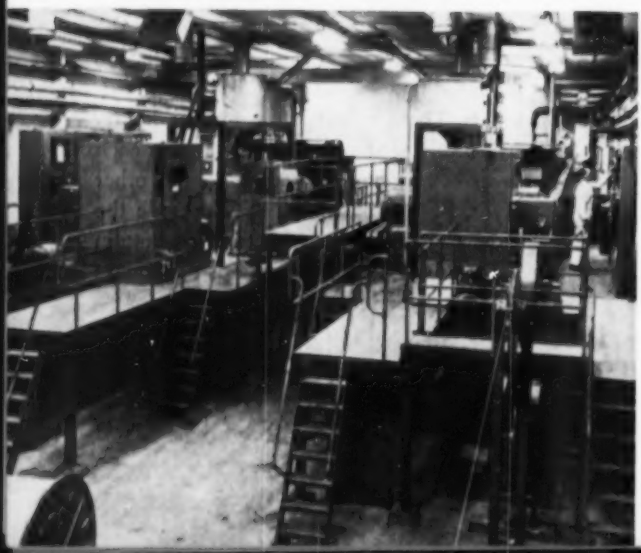
In addition to many other components, each repeater in the Scotland-Newfoundland part of the cable includes three electron tubes manufactured by the Bell Laboratories. These tubes, which receive power from very accurately regulated current sent over the cable itself, operate in three stages—that is, each tube boosts the incoming signal and then passes it along to the next tube. In this process each repeater amplifies the power of the weakened incoming signal some 1,000,000 times.

These tubes are an integral part of a repeater unique because of its shape and construction and the precision and stability of its characteristics. In order to pass over the drum of the cable-laying ship, the repeater has a flexible housing. The center portion of the structure, which is just a bulge in the cable, is almost eight feet long and a little less than three inches in diameter. From this section, the repeater tapers until it is reduced to the diameter of the deep-sea portion of the cable—one and one-quarter inches.

To obtain the necessary flexibility, the nearly 60 components in each repeater are mounted in a series of 17 linked lucite cylinders. These cylinders are surrounded by two layers of steel rings, the rings in each layer overlapping the joints in the other layer. Finely machined, they provide the strength necessary to withstand sea-bottom pressure of about 6,000 pounds per square inch. A cylinder about eight feet long—of copper made to rigid specifications as a protection against any undesirable ef-





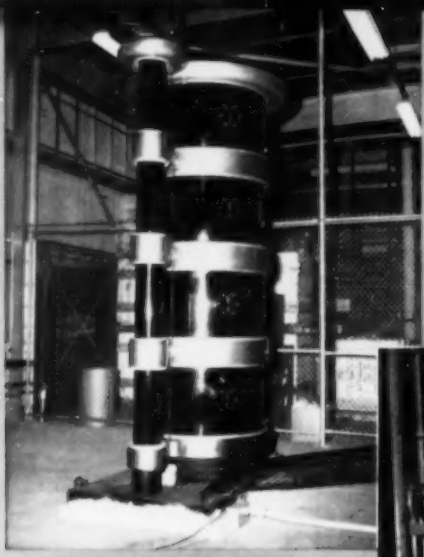


In the Erith Works of Submarine Cables, Ltd.

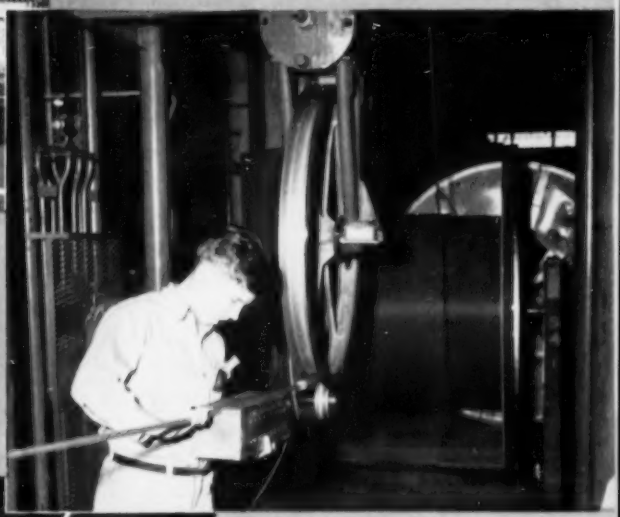
Top: Return taping machines.

Center: Application of return tapes.

Bottom: Two lines of extruders applying polyethylene insulation to the conductors.

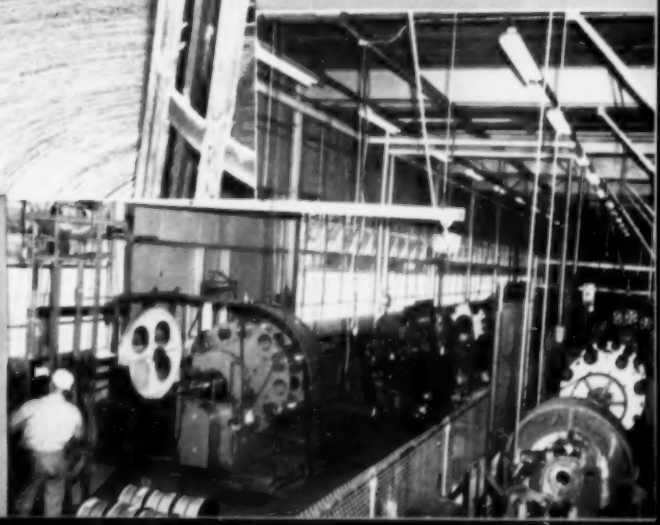


At Simplex Wire and Cable Company at Portsmouth, N. H., this high-voltage testing equipment applies 90,000–100,000 volts to lengths of insulated conductors.



Inspecting cable.

Miles of armored cable are coiled in receptacles such as these.



These machines are applying armor wire to the cable for protection.

fects from the action of salt water—is placed over the steel rings, and then protected by layers of jute and armoring wires. At each of its ends the repeater enclosure is equipped with a system of water-tight seals. The whole structure—including its central protuberance, tapering ends, and final leads—actually makes a complete unit about eighty feet long.

In Hillside, N. J., Western Electric has constructed a factory especially designed to fabricate components and assemble the repeaters for the cable link between Newfoundland and Scotland. This air-purified, temperature-controlled plant might be compared to a clinical laboratory. In order to prevent the entrance of outside dust, lint, or moisture, these quarters are kept under slight air pressure, so that air leaks out rather than flows in. The 250 men and women busy there day and night are probably the most curious looking of all the cable task forces on both sides of the Atlantic—rows of white-capped men and women immaculately clad in white smocks, performing minute mechanical operations or peering through binocular microscopes.

In another part of this unusual looking plant, men are giving the repeater seals helium leak tests in a pressure chamber surrounded with boiler plate. Still others are testing repeaters for leaks with radioisotopes and checking the results with geiger counters behind lead walls.

With the exception of the electron tubes, which come from the Bell Laboratories, all the repeater components are manufactured by Western Electric. The specifications for the raw materials used are so rigid that only the top-rated suppliers of the nation can qualify to serve the project. In the case of the copper tube casing that keeps sea water out of the repeater, for example, exhaustive tests reduce the amount of copper tubing selected to two per cent of all the high quality tubing tested.

Quartz crystals, which must be capable of frequency vibrations accurate to plus or minus 10 cycles within 170,000, are being ground and tested by another Western Electric force at Kearny, N. J. They are then placed within the repeaters at Hillside. Upon assembly and careful final testing, the repeaters are next transported to the Simplex Cable plant near Portsmouth, N. H. Simplex envelopes these repeaters with the same armor used for the cable—work which must be done without producing critical strain, shock, or other damage to their components.

Across the Atlantic, in the Woolwich Works of Standard Telephones and Cables, Ltd., a totally different type of submarine telephone repeater is being assembled from precision-built parts for the cable to cross Cabot Strait. Over the years, British engineers have concentrated on their own immediate repeater problem—the design and installation of repeatered telephone cables between the British Isles and the European continent. Since the English Channel and the North Sea are relatively shallow—about 200 feet as compared with the two and one-half mile depths found in mid-Atlantic—British experience has been chiefly with repeaters designed for use in relatively shallow waters. Thus it is their repeaters which will be used in that portion of the cable system threading the shallow waters between Nova Scotia and Newfoundland.

These British repeaters are housed in a torpedo-like steel case, nine feet long and ten and one-half inches in diameter, similar to the ones the British recently installed in a new cable between Aberdeen and Bergen. Here, too, the utmost precautions are

used in their manufacture. At Woolwich, incidentally, the workers, who are also dressed in white uniforms, have nicknamed their clinic-like plant "the dairy."

The electron tubes—or "valves," as they say in England—to be used in these repeaters are manufactured at the research station of the British Post Office at Dollis Hill, on the outskirts of London. Although separated by an ocean, the research men of both nations have worked together, exchanging ideas and experiences, and they have visited each others' laboratories as well. Now they are reaching the end of a task which has lasted many years in actuality and many more in imagination.

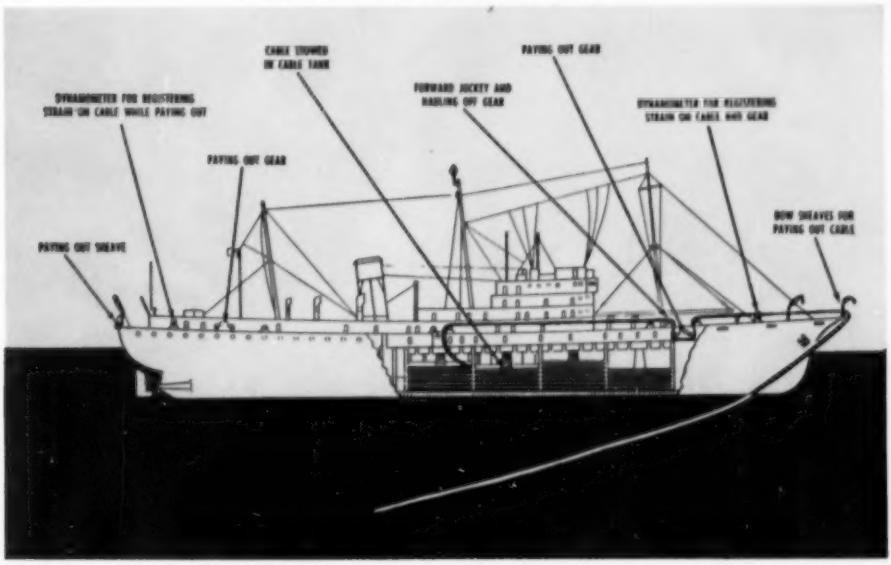
Terminal Equipment

At each end of the twin cables, which together make the conversation path across the North Atlantic, 2,000 volts are fed into both cables—negative and positive potentials totaling 4,000 volts. This power system has been especially designed to feed the correct amount of current to the repeaters under the sea, even under abnormal conditions when magnetic storms may cause currents to be induced in the cable by variations in the earth's magnetic field.

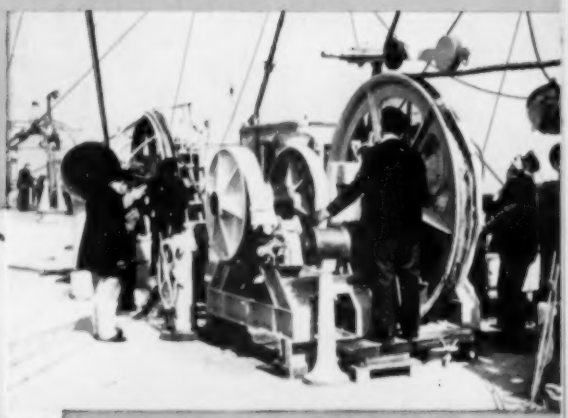
In addition to the power feeding equipment, terminal equipment is provided to separate the individual circuits and for testing. Much of the apparatus for the Oban-Clarenville cable has been especially built by Western Electric for this job. Similar special equipment for the Clarenville-Sydney Mines link is being provided by British manufacturers. Insofar as possible, the standard equipment used in Canada is provided by the Northern Electric Company and other Canadian manufacturers.

In Oban, primary power is obtainable from outside sources, but automatic standby equipment is also available at the terminal. However, at Clarenville only part of the required power is now obtainable

Cut-away drawing of H. M. T. S. Monarch, *showing cable tanks and equipment for paying out cable over either bow or stern.*

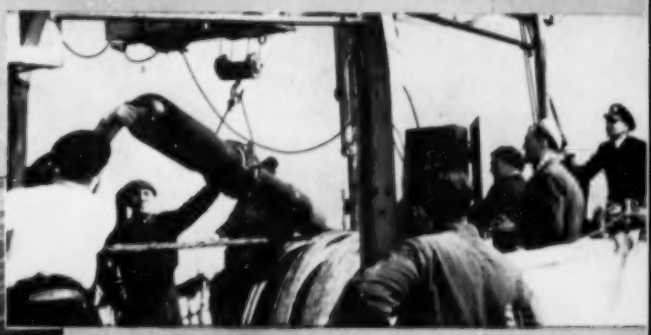

CABLE STOWED IN CABLE TANK
PAYING OUT GEAR
DYNAMOMETER FOR REGISTERING STRAIN ON CABLE WHILE PAYING OUT
FORWARD JOCKEY AND HAULING OFF GEAR
DYNAMOMETER FOR REGISTERING STRAIN ON CABLE AND GEAR
PAYING OUT GEAR
BOW SHEAVES FOR PAYING OUT CABLE
PAYING OUT SHEAVE

An international conference aboard H. M. T. S. Monarch on modifying the cable-laying machinery for laying the flexible repeaters: Present are representatives of the Bell System and the British Post Office and members of the ship's company.



Sheaves over which the cable passes as it moves along toward the bow, and (left) the brake drum which is an element of the laying gear.

Forward deck of the Monarch. *Similar equipment is located on the after deck for paying out cable in deep water.*



Above: A British rigid repeater goes over the bow sheaves and (left) to its resting place on the bottom.

from commercial sources. This terminal therefore houses two diesel engines to manufacture power. These will operate in rotation, to permit periodic maintenance work on them. In addition, so that there will be no cut-off of vitally needed power, an automatic standby engine will also be available.

The radio relay stations in Canada and the United States receive their power from commercial sources, but they too have the standby equipment customary in all stations of this type.

Cable-laying

THE YEARS of experiment and development . . . the work of negotiation and routing . . . the manufacture of cable, repeaters, and special associated equipment—all of these activities culminate in the exacting and complicated task of cable-laying, a task under way as the reader follows these lines. To lay the transatlantic telephone cable, the largest cable ship afloat—*H.M.T.S. Monarch*, 480 feet long, which has a capacity of 8,050 gross tons—has been refitted at the Telcon Works, up the Thames from Greenwich, near the Isle of Dogs. Incidentally, the "Great Eastern," the famous ship which laid the transatlantic telegraph cable of 1866, the first to be successful, was built at the Isle of Dogs.

When she was completed, nine years ago, the *Monarch* was equipped with all the latest devices for placing submarine cable. However, the new flexible repeaters required a modification of her equipment for the present job. As these repeaters would be damaged if they were bent around a drum less than seven feet in diameter, practically every part of the original cable-laying machinery had to be replaced. Some of the new machinery involves the first fundamental changes in the design of such gear since the days of the "Great Eastern." These new designs have been carefully worked out by engineers of the Bell System, British Post Office, and Telegraph Construction and Maintenance Company in order to combine the experience of years of cable-laying and the requirements of these new repeaters.

In mid-March a dress rehearsal of the summer's big job got under way in the relatively shallow waters of the Bay of Cadiz, near Gibraltar, and later in the deeper waters off Africa, west of Casablanca. Some 45 miles of cable, containing four of the flexible and one of the rigid repeaters, were payed out from the *Monarch* as experts from both sides of the Atlantic watched the result. The ship's bow machinery was used in the test off Gibraltar, while the stern apparatus was utilized in letting the cable down to the two and one-half mile bottom off Africa. Motion pictures were taken of the cable coming out of the tanks below decks, passing around the drums and through the cable-placing machinery. The whole process was carefully studied so that anything which could prevent a perfect performance this summer would be anticipated and corrected.

The *Monarch* next steamed off into the Atlantic to load the American-made portion of the cable at the Simplex plant near Portsmouth, N. H. As suggested in the opening paragraphs of this article, Clarenville, Newfoundland, was the next port of call. The sight of the 8,050-ton ship, bulking large against the low hills of the nearby bay, symbolized the importance of the cable-laying operation in the history of this development in overseas telephony. From these waters, the *Monarch* turned her bow eastward, paying out cable along her prescribed route on the initial stage of her cable-laying job. (The second chapter

Oban, Scotland, is where the eastern end of the cable comes ashore.

Path-loss testing was important in selecting the route of the radiotelephone link between Portland and the Nova Scotia cable terminal.

The terminal building for the western end of the transatlantic cable is at Clarenville, Newfoundland.

H. M. T. S. MONARCH *entering Portsmouth harbor.*

The route of the transatlantic telephone cable system is one Alexander Graham Bell undoubtedly would have preferred to all others: New York and Montreal to London, via New Brunswick, Nova Scotia, Newfoundland, and his native Scotland. The inventor of the telephone sleeps in a simple tomb carved out of the native granite of a mountain top on his summer estate at Baddeck, Cape Breton Island, Nova Scotia. Crossing the waters of nearby Bras d'Or Lakes, the voice channels of the radio relay approaches will pass the very mountain where Mr. Bell is interred. Within about a mile of the estate, the Canadian Government has built an Alexander Graham Bell Memorial Museum which is being opened this summer.

is scheduled for next summer.) Several factors caused this path to be selected—a comparatively short route that avoids ice floes, fishing trawlers, and the paths of existing telegraph cables.

Radio Relay Facilities

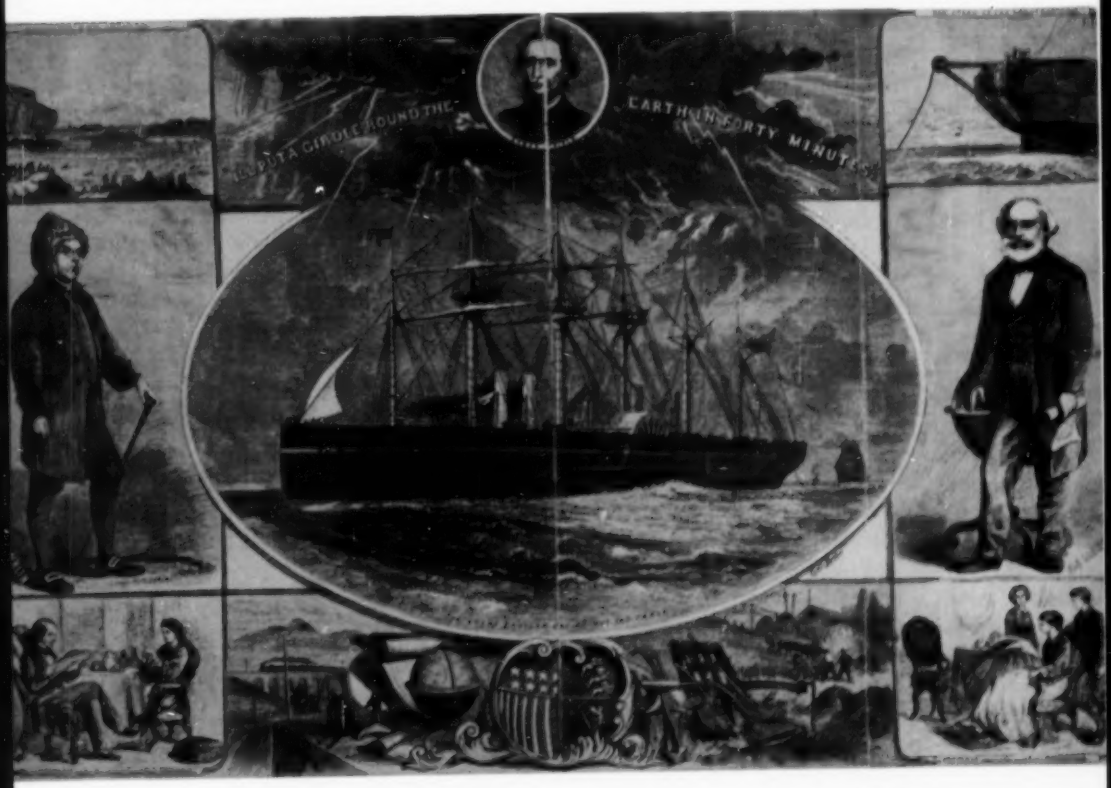
LAST YEAR, engineers examined the terrain between Sydney Mines, Nova Scotia, and Portland, Maine, setting up temporary towers to make "path loss" tests to determine radio relay transmission conditions between prospective station sites. The availability of access roads and local power was studied, and the final route was established. Right-of-way was procured, often a complicated task involving exhaustive title searching.

The American sector of the cable system is now in various stages of preparation for its ultimate task. The first two radio relay

Cable-laying apparatus used 90 years ago—from a contemporary magazine.

The laying of the first transatlantic telegraph cable was an internationally celebrated event.

BETTMANN ARCHIVE



On both sides of the Atlantic, individuals possessed of a variety of skills and representing many organizations have worked in close cooperation to make possible the construction of a telephone cable across the North Atlantic. Included in this large group are scientists, engineers, technicians, lawyers, financial specialists, office staffs, and administrators in the British Post Office and its Research Laboratory, the Canadian Overseas Telecommunication Corporation, the Eastern Telephone and Telegraph Company, the Northern Electric Company, and various units of the Bell System—the Bell Telephone Laboratories, the Western Electric Company, and the General Departments and Long Lines Department of the American Telephone and Telegraph Company. In addition, the companies supplying the materials for the cable and its apparatus, and others which are constructing buildings and towers or laying the cable, include a number of the leading business organizations of Great Britain, Canada, and the United States. They all take great pride in their contribution to the success of this historic undertaking.

stations beyond Portland—Brunswick and Liberty, which were originally set up as part of the Bell System domestic network—are being modified for their increased responsibilities. Work is under way on the next station, King's Mountain, where the tower will rise more than 260 feet, and the stations at Franklin and Cooper Hill are also under construction.

Already seven radio relay stations in New Brunswick have been erected, and five others in Nova Scotia are in process of construction. The radio relay station and cable terminal at Sydney Mines, Nova Scotia, is also under way. In addition, the thirteen towers in this section of the system are being erected. Installers of the Northern Electric Company of Canada are busy putting equipment in these stations.

Construction crews, with bulldozers, back hoes, drag lines, air hammers, and dynamite, are at work digging the trench and laying the land cable across Newfoundland for the rugged 50-mile stretch between Clarenville and Fortune Bay. This portion of cable is being completed this summer so that it will be ready to connect with the submarine cable to be laid next spring in Cabot Strait between Newfoundland and Nova Scotia. This work is being done by contract under the supervision of engineers of the British Post Office, Canadian Overseas Telecommunication Corporation, and Eastern Telephone and Telegraph Company.

The cable stations at Clarenville, Newfoundland, and Oban, Scotland, were completed several months ago, and terminal and power equipment has been installed and tested. Radio communication circuits have been set up so that these stations and the *Monarch* will be in constant communication during the cable-laying operation. Radio range equipment has also been set up so that the exact position of the ship and the cable can be determined, regardless of fog or weather conditions.

Bell System Organization

MANY COMMUNICATION ORGANIZATIONS and manufacturing companies on both sides of the Atlantic are playing their parts in completing this great undertaking. On these shores the Long Lines Department of the American Telephone and Telegraph Company and its Canadian subsidiary, Eastern Telephone and Telegraph Company, are charged with the Bell System responsibil-

ities for the enterprise. This includes all phases of the project, such as financial arrangements, selection of route, supervision of cable laying, construction of cable terminal and radio relay stations, scheduling and follow-through of the manufacture of cable and equipment.

In an international undertaking of this character there is necessarily a large volume of liaison work. A radiotelegraph printer has been established to handle correspondence between New York headquarters and London, so that policy decisions, interchanges of technical information, and a host of routine matters may be arranged between the participants. Montreal and Sydney, N. S., are other points in this administrative rectangle which settles methods for handling cash disbursements over the border, legal and auditing matters, and problems of supply.

As the *Monarch* plows eastward towards Oban, with the cable flowing over her stern, those involved in its accomplishment occasionally let their thoughts turn to earlier milestones in communication. Morse's classic statement about the telegraph, "What hath God wrought"; Cyrus Field's ultimate triumph in laying the first transatlantic telegraph cable; and Bell's familiar, "Mr. Watson, come here, I want you," all come to mind. Soberly, the men responsible for this important new venture also give respectful heed to the awesome might of Nature, whether expressed in terms of aerial forces or the power of the sea. Yet the very need and pioneering aspect of the telephone cable project stimulates them, encourages their confidence, and makes them believe, with the Archbishop of Canterbury in Shakespeare's "King Henry V":

As many arrows, loosed several ways,
Fly to one mark;
As many several ways meet in one town;
As many fresh streams meet in one salt sea;
As many lines close in the dial's centre:
So may a thousand actions, once afoot,
End in one purpose, and be all well borne
Without defeat.

Three successive MONARCHS *have borne this plaque, beginning in 1877.*

A guest editorial

LIVING WITH GOVERNMENT

T. BROOKE PRICE

Vice President and General Counsel, A. T. & T. CO.

It is a striking fact that the Bell telephone companies are made up of more people in more places than any other business in America. I speak of these people as being themselves the telephone companies because corporations really consist of people, and a nation-wide service requires nation-wide distribution of people.

It is not surprising, therefore, that our people have to deal with government in more places, under more forms and in more ways, than the people in any other single enterprise. Telephone people touch government as it is embodied in the national administration with all its ramifications, in the states, the counties, the cities and towns, the districts, the wards and boroughs in every section of the country.

Year by year, more kinds of government activities present themselves, administered by more officials and agencies. Legislation creates new types of regulation and sets up new governmental authorities. Administration becomes more complex and twines itself more deeply into the structure of American business. The process goes on in some measure in all industry, but nowhere so intensely as with the public service enterprises, and among them nowhere in such sheer magnitude and geographical scope as with the Bell System.

Living with government is thus an increasingly important part of the telephone career. Whether it is dealing with the local assessor or with the governor of the state, whether it is securing a street-opening permit or testifying at a Congressional hearing, the task is part of the never-ending operation of keeping the telephone business in alignment with the complicated structure into which our government has grown.

Since government has become such an important factor in the business, the telephone man must deal with it in business-like fashion. He must make sure in every case that there is a clear understanding of the facts and an appreciation of the reasons which require the action sought. A favorable reception of what he has to say is of first importance. This is best secured by having first gained the confidence of those with whom he deals. But underlying the whole relationship are deeper considerations which must never be overlooked.

These considerations apply throughout this whole great aspect of our business, manifold and diversified as it has become. From moment to moment and from place to place particular incidents occur and particular problems have to be faced; but no incident and no problem counts as impor-

tant in itself in comparison to the overwhelming importance of maintaining in all times and places a sound relationship between the Bell System and government. In these days, to live with government harmoniously, effectively, and with self-respect is one of the most serious and delicate responsibilities telephone people must face. It can only be accomplished by holding steadfastly to basic principles.

The first of these principles, I think, is to preserve unimpaired the reputation and standing of the Bell companies, nationally and locally, for integrity, responsibility, and fair dealing. I say preserve because that is generally the reputation our companies have borne down through the years. The telephone system stands in the public eye as a great national institution of high character. That reputation is an asset of immeasurable value, which in the past has served the System well when other businesses have fallen into disrepute and suffered in consequence through punitive legislation or regulation.

The second principle is the importance of taking the long view. Public officials change from time to time but the telephone business will still go on. In solving the problems of today we cannot afford to compromise the future. Any expedient that is wrong for the long pull will not do even for the moment.

An old lawyer gave me some advice in my youth that I shall never forget. He said

> "Don't try to get the better of your opponent in a law-suit by a smart trick. Smart tricks don't pay. It is worth more to be known as the kind of man who doesn't resort to smart tricks."

It is worth more to the Bell System, too, that its representatives shall be known as people of that kind. Lawyers need such a reputation with the courts; telephone peo-

ple need it with government. What can't be got by square-shooting costs more than it is worth.

The last principle in my list is traveling the middle of the road. People come and people go; the sun shines at first on one side of the street and then on the other side. No corporation that must maintain important relations with government can afford to tie up with any party or faction. The much-sought alliance with the political powers of today may secure only disfavor from those in power tomorrow. And just as it is dangerous to plant oneself in any man's political camp, so it is wrong to accept any man in public life as an irreconcilable enemy.

For we shall get what we are entitled to ultimately, regardless of the hostility or favor of this one or that one, on the merits of what this business requires in the public interest. So long as the telephone companies continue to earn public approbation and support by good service and high standards of conduct, government, by and large, will deal fairly with them.

Installers and repairmen have important role in Plant Sales Program which aims to bring complete service to customers and added revenue to the companies

WIDER HORIZONS FOR THE PLANT DEPARTMENT

RUDOLPH EKLUND

Plant Sales Engineer, O. & E. DEPARTMENT, A. T. & T. COMPANY

A NEW WORD was born to us in 1954: *merchandising.* No one word or activity in our business has claimed so much attention or grown so rapidly as has merchandising. It's been a tricky word from the start, subjected to many definitions and to many obstacles; but it also has been a successful word—and a successful way of business. And as yet we have just begun to explore the magic of it and have just begun to feel the wallop of its punch.

Operationally, our Commercial Service Representatives, along with our General Sales and Servicing people, have long geared their efforts to meet this newcomer, and they're doing a good job. So are our Directory Sales people. Traffic, too, has experienced success in the promotion of long distance usage.

But a new dimension is rapidly making itself felt in the field of merchandising. It's *Plant Selling.* Already tremendous strides have been made in this area by Plant people, and their accomplishments point toward future expansions and recognition.

In this the infancy of merchandising, Plant people in only six months of recorded sales have racked up an impressive record of 107,000 extension telephones sold. On a going-rate basis, all Plant sales add up to a whopping figure of over twelve million dollars of additional annual revenue.

But—just as important to us in Plant—thousands of our customers, perhaps for the first time, are experiencing the satisfactions of complete telephone service: service that has permitted them to use our equipment to advantage and to get full utilization and benefit from it.

It is against this background that we want to examine the concept of telephone merchandising, and the role which we as Plant people have in it—the concept of better service through sales.

Signs of Changing Times

LOOKING BACK to see how far we have gone forward—How many times has this question been asked?— "Now let's see—where do *you* think we should have the tele-

Telephone men are confidently approaching the public with a complete service package.

phone?" And how many times has the answer been, "How about here in the hall, or at the end of the living room—so that it'll be in the middle of the house." Probably more times than we like to remember, that brief conversation has been acted out by a customer and an installer.

But no longer is the question being greeted with a stock answer. The scene has changed and the installer's part is a happier one now. In the words of an installer from Illinois, "A couple of years ago, when we were short of instruments, I'd tell customers to put the phone in the center of the house. But now I try to find out and give them what they need. I point out the advantages of having two or even three telephones in different parts of the house. I tell them about colored telephones too."

"Actually, customers have appreciated my suggesting items which have improved their service. And I feel a heck of a lot better about it too. I never cared much about telling people they had to wait for service or that they couldn't have another telephone."

True, the words were spoken in Illinois—but like words and like thoughts are being echoed in garages and work locations everywhere. They have served not only to announce the arrival of Plant Selling, but to recognize that the real producers in Sales have found satisfaction in providing customers with complete service.

Providing Good Service

It is and always has been the belief of all of us in the Bell System that our first duty is to provide the public with good service. From the technical point of view, we have been successful in providing that service and in making provisions for even better service. Our 4A machines, CAMA, answering sets, and distant talking sets—just to name a few items—attest to this.

But there is more to good service than equipment and machines. Implied also is a thoughtful and responsible job by those who render this service; by those who come in contact with our customers. Into this sense of thoughtful responsibility the concept of telephone merchandising fits; the

concept of providing for the telephone wants as well as the telephone needs of our customers; to make available to them for their convenience and pleasure the very best and most complete telephone communication service possible.

To this end, that we might acquaint and better serve our customers with what we have to offer in the telephone line, we have turned to active, aggressive selling—the end product of a merchandising program.

This was something new to many Plant people. Some of us remember the "sell-a-phone" days of the depression of the 1930's, but to most of us it was to be a new experience, a new challenge, and a new way of life.

What happened?

Plant men and women who had been reared in an era of inability to meet demand eagerly began taking advantage of opportunities to promote better service:

On trouble tests, deskmen are suggesting and selling extension telephones.

Assignment clerks are providing information resulting in customers upgrading to a better class of service.

Repair clerks and order clerks, framemen and switchmen, are beginning to think and talk merchandising.

Heard everywhere, "There seems to be no limit to the services people can use." But the hard fact remains that we have to merchandise our services actively if we're to serve fully. We have to make people aware of their needs and what we have to offer.

"Most people don't realize," said an installer in Pennsylvania, "how little an extension telephone adds to their bill. People who have never had one don't realize how convenient they are. It's up to me to tell them and they thank me for it. As I see it, *Selling is Telling.*"

By whatever name you call it, be it merchandising or selling or servicing, by telling the customer and perhaps even showing him what we have in the telephone line, new telephone wants can be created in his mind—telephone wants which can help make his modern way of living a little easier, a little more convenient, and a little safer.

The Role of Plant Contact People

NO ONE is better qualified to do this than an installer or a repairman. Theirs is a unique and very select opportunity. As one man observed, "I'm not faced with the problem of getting inside of a door; in my hand is a service order, an invitation from the customer to come into his home."

There are many things about a Plant visit to the homes and places of business of our

To show customers how an extension telephone would look in place, an installer takes two telephone sets to the door.

customers which enhance the value of the contact as a sales as well as a servicing opportunity.

To begin with, the Plant contact man is probably the only representative of the company many people ever see face to face. To them he is "Mr. Telephone." They recognize his expertness in the field of communications and they look to him for advice.

Then too, the visit comes at a time when the customer is probably more receptive to constructive suggestions for improvements in his service than at any other time. He's thinking about his telephone service and is willing to—in fact generally wants to—talk about it. Typically, an installer in Oklahoma says, "You can go into any house and show the customer exactly what he needs for good service and where he needs it. It's easier to sell, too, when you can see the customer's face as you demonstrate the convenience of additional service."

And that's the key opening the door of opportunity. You are with the customer right where he's asking for service. You can see what the place looks like. You can look around and observe some of his evident telephone requirements and, through a perfectly normal and natural discussion, determine some not so evident. Put it together and the door is wide open. You know what he needs or should have for full service and you know what you have *available* in the telephone line to satisfy those needs. Suggesting it to the customer is the start of a sale.

There is hardly a limit to the service we can render the customer, and only the ingenuity of the installer or the repairman and the needs of the customer should limit the results in so far as sales is concerned.

"This is the set I was telling you about. You'll really like it in the kitchen. It will be a big convenience for you there."

"How about this location?" an installer asks. With the customer he helps decide where the telephone will go. He knows that location is important if it is to be convenient and used.

Package Selling

THE IMPORTANCE of doing a complete "package" service job on the initial installation visit can't be over emphasized. Selling complete service at one time has many advantages over selling "by the piece." There is only one installation visit, the customer doesn't have to wait for the service he needs, we get the revenue from the time of the sale.

As long as there is something our customers want or need in the line of telephone service, they are not getting the best service. Unfortunately, for a period of almost fifteen years we were in the position of not always being able to give an adequate or full service.

It's significant that those unhappy days of shortages and restrictions were with us for so long that many of our customers now *think* in terms of shortages. They are putting up with inadequate service because they think that it's the best that is available. And there is no escaping the fact that we have had a lot to do with that thinking, for we encouraged them—even insisted—to accept far less than complete service. Basic service, we called it.

But now that our restrictions and waiting lists are fast disappearing in most places, we in the telephone company have an undeniable obligation to let our customers know what is available to provide the service that best meets their needs. That is the first objective: to market all our telephone services so that customers' needs are anticipated and fully satisfied. The more convenient and personally satisfying we make our service, the more closely we approach

Garage meetings were held to introduce Merchandising to Plant people.

Sales is a subject at brief informal meetings held by Plant foreman before installers and repairman leave for the job. The latest supply report is discussed here.

our goal of providing the best possible service to our customers.

To be sure, some shortages still exist, but our huge construction programs are fast catching up to them.

And—thank goodness!—the instrument problem is easing. Telephone set production is at full throttle. Expanded manufacturing facilities have paved the way for a record-breaking production year in 1955 of five million telephone sets. Over a million and a half more than that produced in any other year!

In this atmosphere we as Plant people have a responsibility to *assure* that our customers have what they need or want in telephone service, or that we at least make known to them what is available to make their service modern, up-to-date, and more useful.

This is not a one-man or a one-group or a one-shot job by any stretch of the imagination. Far from it! The coördinated job of creating a market favorable and receptive to our services is part of everybody's job.

Everybody's Job

Emphasizing this, interdepartmental merchandising committees have been established in many companies. Generally these committees have outlined the objectives of a merchandising program, have helped set up training and employee information programs, and have been a sounding board for ideas designed to stimulate interest and activity in the program in general.

Along with this, employee information programs generally are under way to acquaint *all* our people with the philosophy of merchandising: what it is, why we're in it, their part in it, what we have to sell, and perhaps how to go about selling it.

The Public Relations people are active. Public displays—"Telephone Super Markets"—in the lobbies of company buildings and at home shows and open houses have been instrumental in introducing to the public some of the equipment and services which we have to offer. Some of our employees, too, are seeing for the first time many of the new items in the telephone line at these displays.

Letter stickers, bill inserts, posters, even billboards have been recruited to take the sales message to the public.

Key to Success: Tell the Public

A BIG PART of any sales program is merely telling. Telling the people whom you meet about what's new in telephone service, what's available to them, and how they can make their telephone service more convenient, more useful, and more valuable.

The spotlight is on everything that will improve the telephone service of our customers; whether it be an additional listing, a long distance call, credit cards, or an arrangement of equpiment to best suit a customer's individual needs. They all add up to better service and improved revenues.

Sales Minded Training Programs

THERE WERE some problems when we turned to Plant Selling—yes. It isn't easy to break from tradition—and for many years to our customers we'd been saying mostly "no" and little else. Small wonder then that "I don't know anything about selling. I can't sell. I wouldn't even know where to begin," was a voice heard early in the program.

To help reverse the polarity of this thinking, in fact to help *all* Plant people recognize opportunities for sales and how to capitalize on them, sales-minded training programs of a participation type were designed. Stressed in these programs was the importance of naturalness, the importance of being yourself and of talking to customers in your own way and manner. Featured too was the service angle—giving the customer complete and adequate service the first time out. Genuine sales—sales to improve the value of our service—were highlighted! We're not in a sales program just to sell pieces of equipment; we're in a merchandising program to give better service and through better service to realize additional revenues.

With facilities and supply still a variable to be reckoned with, without program and control, we could sell ourselves, in some cases, into shortages and unfilled orders again. We do still have some unfilled orders and our very first business is to satisfy them as quickly as possible. And we want to take care of all our "over the counter" business too. So there are no universal rules of the thumb to apply to our merchandising program except one—to sell the items we do have when they are available or reasonably available, to the end that we may serve adequately as many customers as possible the very first time we visit with them.

An Unlimited Market

THE BEST PART of this sales story is that there is a good sales market. Economists tell us that the discretionary spending power of the nation—the amount of money left over after paying fixed expenses—is four times that of 1940. It means that the

public is in a better position to buy our services.

If we're to meet this challenge and the challenge of this market, there's a job to be done by all of us in the Plant Department. Telephone service contributes much to good living and to good business. Part of our Plant job—to the best of our ability—is to make sure that our services are so attractive and so pleasing that people will *want* them as much as they want the other items that compete for their favor.

The time has come to cast overboard the ancient idea of one black telephone in the center hall. How aggressively we sell our products today will determine whether multiple extensions and new advances in the telephone art become as commonplace tomorrow as the single telephone is today.

Just think of the potentialities if every installer and repairman became inspired to absorb this servicing job into his everyday thinking. When you reflect for a moment that we have a total of more than 25 million customer contacts a year in the Plant Department—25 million opportunities to give our customers more complete service through the sale of extensions, additional lines, colored telephones, loud ringing bells or any of the many other items of service we have to offer—it is, indeed, an exciting and challenging horizon we have before us.

Everybody is interested in the telephone.

613-LO4-5678: This is the sort of number you will dial one of these days to reach distant telephones throughout the United States and Canada

DIAL SERVICE IS EXTENDING ITS REACH

ROBERT G. ELLIOTT

Assistant Chief Engineer, AMERICAN TELEPHONE AND TELEGRAPH COMPANY

BACK IN 1928, when I first went to work for the Bell System, a total of about 14 million System telephones were in service. Now, 14 million of anything is a tremendous number; yet at the present time the Bell System serves something over 43 million telephones—which is a lot more.

What has caused this growth? Population increase, of course; but, additionally, a continuously improving and more valuable telephone service.

The one product we have for sale is communications, and as long as we continue to improve that product the demand for it will grow.

In the years past we have improved the quality and scope of the service we render. Telephone service has been mechanized locally, it has become faster, and it is much more widespread.

As another phase of our efforts toward a better and more nearly universal telephone service, a program was launched a number of years ago which has as its ultimate objective direct dialing of calls between any two telephones in the United States and Canada. The billing information for such calls will be recorded automatically, and connection will be established without assistance of an operator. This program is a major undertaking in all respects: planning, development and research, financing, and construction by the Bell System and Independent telephone companies. We may think of it as progressing steadily—even rapidly—along four principal and closely interrelated lines:

Local Mechanization
Telephone Numbering Plans
Automatic Long Distance Switching Plan
Automatic Recording of Billing Information

To be successful, the direct distance dialing plan must provide arrangements that are simple and easy for customers to use. This requirement is fundamental to all the planning work.

Numbering Plan areas and codes for the United States and Canada.

Today's view of the basic dial switching network in 1965.

Local Mechanization

IN THE 1920's, when the Bell System had relatively few dial telephones, it was decided to go ahead with a local mechanization program and gradually to convert the local manual service to dial, over a period of years as opportunity was presented. This program has progressed continually over the years from 2 percent in 1920 to 84 percent in 1954. Present plans show that by 1958, about 95 percent of all telephones will be dial—and the 100 percent mark will be approached shortly thereafter.

Telephone Numbering Plans

A PRIMARY REQUISITE for nation-wide customer dialing is that each customer be assigned a distinctive telephone number—one that does not conflict with the number of any other customer in the United States and Canada. It is essential that these numbers be similar in form, be convenient to use, and that they be compatible with local and extended-area dialing arrangements.

Telephone numbers for nation-wide dialing will consist of two parts: an area code of three numerals, to designate the geographical numbering-plan area; and a directory number, consisting of the first two letters of the central office name followed by five numerals, commonly termed 2–5 numbering.

The United States and Canada have been divided geographically into over 100 *numbering-plan areas*, each of which is assigned a distinctive 3-digit designation called the *area code*. Calls from one numbering plan area to another (known as foreign-area calls) will, in general, require dialing the code of the area in which the distant customer is located as well as his directory number. Home-area calls, which originate and terminate within the home numbering-plan area, will ordinarily require dialing only the called customer's number as listed in the local directory.

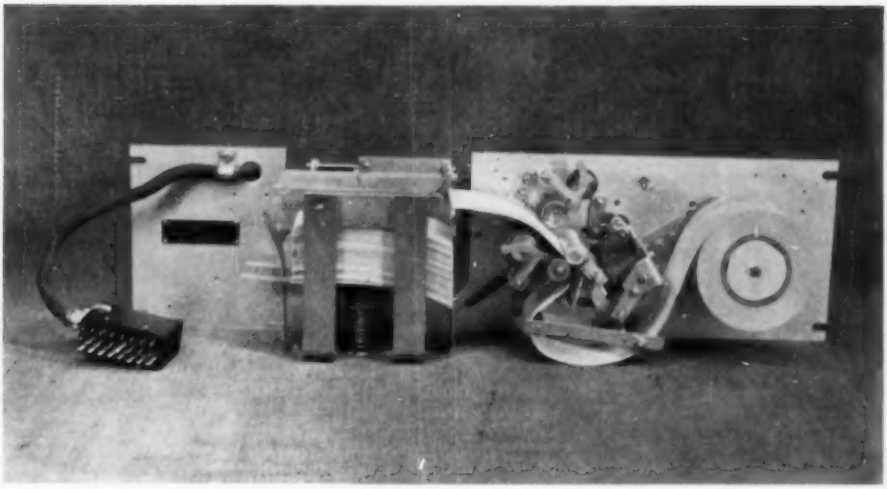
About 50 percent of the more than 43 million telephones in the System are now arranged on the 2–5 numbering basis. It is expected that about 75 percent of these telephones will be so numbered by 1957, and that the job will be approaching 100 percent completion by 1960.

Automatic Long Distance Switching Plan

ANOTHER BASIC REQUIREMENT for nation-wide dialing is a switching plan that provides for routing traffic automatically and rapidly between any two locations.

A general switching plan for handling long distance traffic on a manual basis has been in operation for more than 20 years, but some modifications were necessary to adapt it to nation-wide dialing.

Photographing a bank of message registers used for bulk billing of customer-dialed calls.

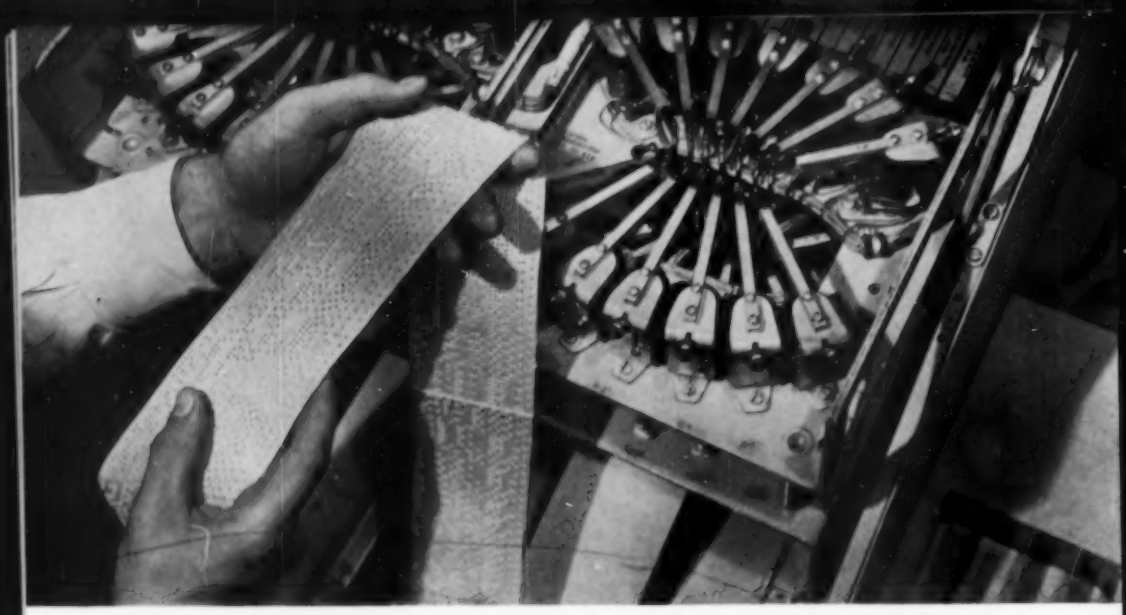


An automatic ticketer, which prints tickets of customer-dialed calls.

All offices in the country have now been classified according to their position in the switching plan. This classification divides the country into switching areas, termed regional, sectional, primary, and toll center (the latter is a long distance switching center serving directly a group of local offices). There are nine regional areas in the United States and two in Canada, each served by a regional center. There will be about 225 important switching points within these areas. Some 60 major locations will require the 4A toll crossbar type of switching system, with approximately 165 other locations having systems with lesser switching capabilities. Of the 60 major locations, 34 have already been provided with No. 4 toll crossbar equipment, 10 more are planned to be in service by the end of 1956, and it is expected that the balance of these major locations will all be equipped with No. 4 equipment by 1960. The other important switching points have been or will be equipped with crossbar tandem, #5 crossbar, or step-by-step systems for switching purposes.

All of these switching points will be interconnected by a network of intertoll trunks in accordance with a fixed pattern. Every local office will have a last choice or "final" route to its toll center, each toll center will have a "final" route to a primary center, each primary center will have a "final" route to a sectional center, and each sectional center will have a "final" route to a regional center. It is not necessary that this complete chain be provided in all cases. For example, some toll centers will have final routes to sectional or regional centers, and some primary centers will have final routes to regional centers. One of these regional centers, St. Louis, has been tentatively classified as the national center, and all of the regional centers will have a "final" route to the national center. Thus, any local office can be connected over this final or back-bone route chain to any other local office in the country. However, it has been estimated that only a few calls in a million will ever have to be routed over this final path.

A great many calls will be routed over



AMA perforators, which record billing information on a punched AMA tape.

direct or so-called "high usage" trunk groups. These high-usage groups will be provided between all classifications of switching centers where there is sufficient traffic to make them economical. This plan, which is being introduced in an orderly fashion, permits automatically rerouting calls over alternative routes when "all circuits busy" conditions are encountered on direct routes. It makes possible the use of margins in one route to relieve congestion on another route to a much greater extent than under manual operation.

The last choice is the "final" route to the next higher switching center.

The ability of the automatic switching machines to test rapidly a number of different routes for an idle path makes alternate routing possible and where used will give long distance service with essentially no delays.

At the present time about 55 percent of the intertoll trunks in the country are provided on a dial basis, which are used now largely by operators and only to a small extent directly by customers. Rearrangement of the network to the high usage and final route basis has already begun, and plans call for rapid strides in this job during the next few years.

Automatic Recording of Billing Information

DIRECT DIALING of calls beyond the local calling areas requires that certain data be obtained automatically in order that chargeable calls can be billed. Some service between near-by points is furnished under zoned or multi-unit plans, which employ "bulk" billing. This requires only the number of message units to be associated with the calling number. Other service between near-by points and all long distance service is furnished under rate plans which require detailed bills. The minimum data which are required for detailed billing include:

The called telephone number (7 or 10 digits)
The calling telephone number (7 digit)
Date
Time of day
Length of conversation

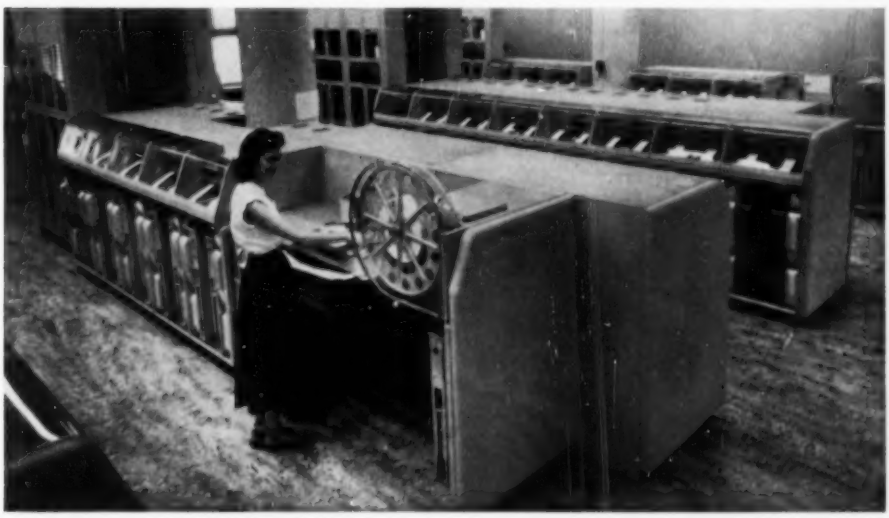
ZONE REGISTRATION. In the late 'twenties, investigations were made to see whether the dialing ranges could be extended be-

yond the local dialing area. The best opportunities were found in the large metropolitan areas, which could be subdivided into various rate zones and message-unit charges applied between the various zones. Electric counters called message registers were associated with customers' lines in panel-type dial equipment and used to record the number of units required for charging purposes. This arrangement is known as zone registration and was the first arrangement used by the Bell System for automatically recording billing data on a bulk-billed basis.

The service was first introduced in New York in 1931 on panel equipment, and also applied to No. 1 local crossbar offices when this system was introduced in the late 'thirties. By the beginning of World War II, six of the largest metropolitan areas in the country had this service. These were New York City, Boston, Chicago, Northern New Jersey, San Francisco, and Philadelphia. At first zone registration was limited to two or three message units, but was gradually extended to five message units. The largest volume of messages handled by this system today is in New York City.

AUTOMATIC TICKETING. Need also developed at an early date for equipment to record billing data in step-by-step areas—especially in Los Angeles, where the short-haul calling rate was very high. To meet this need, the automatic ticketing system was developed, and was first introduced in the Los Angeles area in 1944. With this system, customers can dial 7-digit home-area calls and the billing information is automatically recorded on a ticket, which is manually processed in an accounting center in the same way as is a ticket prepared by an operator.

This service is now in use in over 20 locations in the Los Angeles area and in some offices south of San Francisco, and the customer is able to dial calls over distances for which he is charged up to eleven message units. Developments have just been completed whereby this system can be modi-



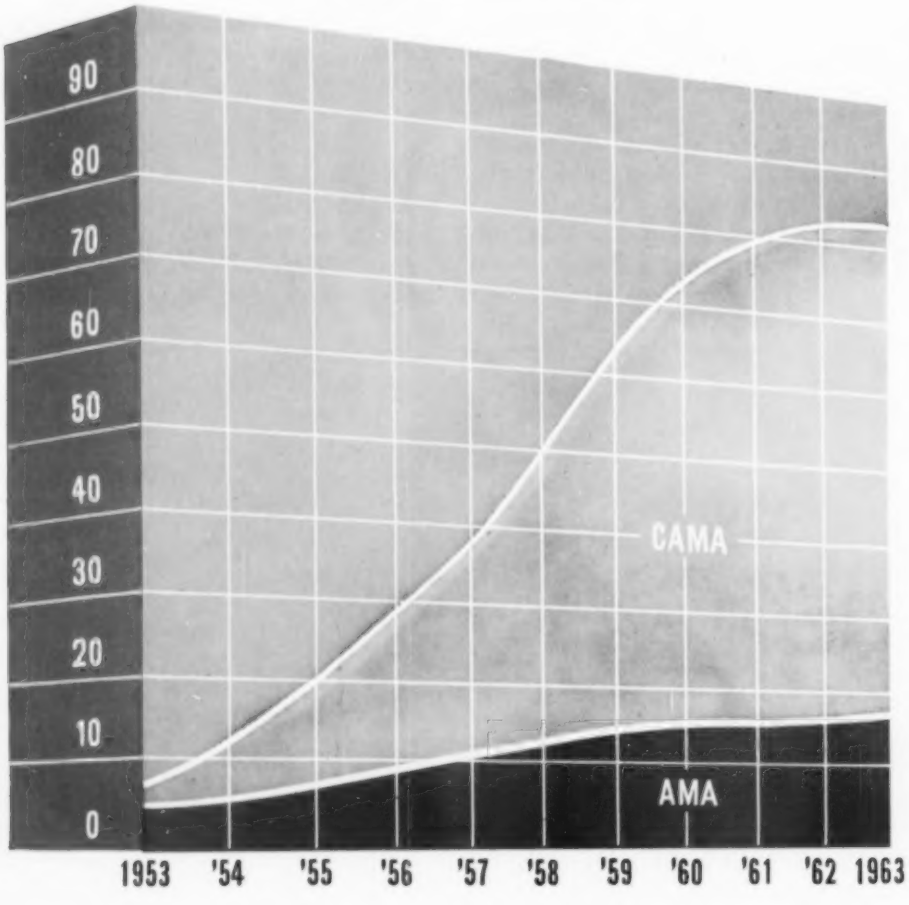
Machines in an automatic message accounting center which are used to process AMA tape.

fied to produce a standard AMA tape (as described in the following section) instead of a ticket. This will allow these tapes to be processed in the same accounting centers provided for AMA. This new automatic ticketing arrangement will be capable of handling both 7-digit home-area and 10-digit foreign-area called numbers.

AUTOMATIC MESSAGE ACCOUNTING. Following the war, work was started on the development of a system for recording billing data for use with local crossbar systems. This system, known as automatic message accounting (AMA), was first placed in service in 1948 in Media, Pa. The information needed for accounting purposes is punched into a special paper tape, and these tapes in turn are processed in an automatic accounting center. Messages can be billed either in bulk or in detail.

An accounting center can, of course,

Estimate by years of the percentage of main telephones having access to automatic message accounting centers or to centralized AMA.

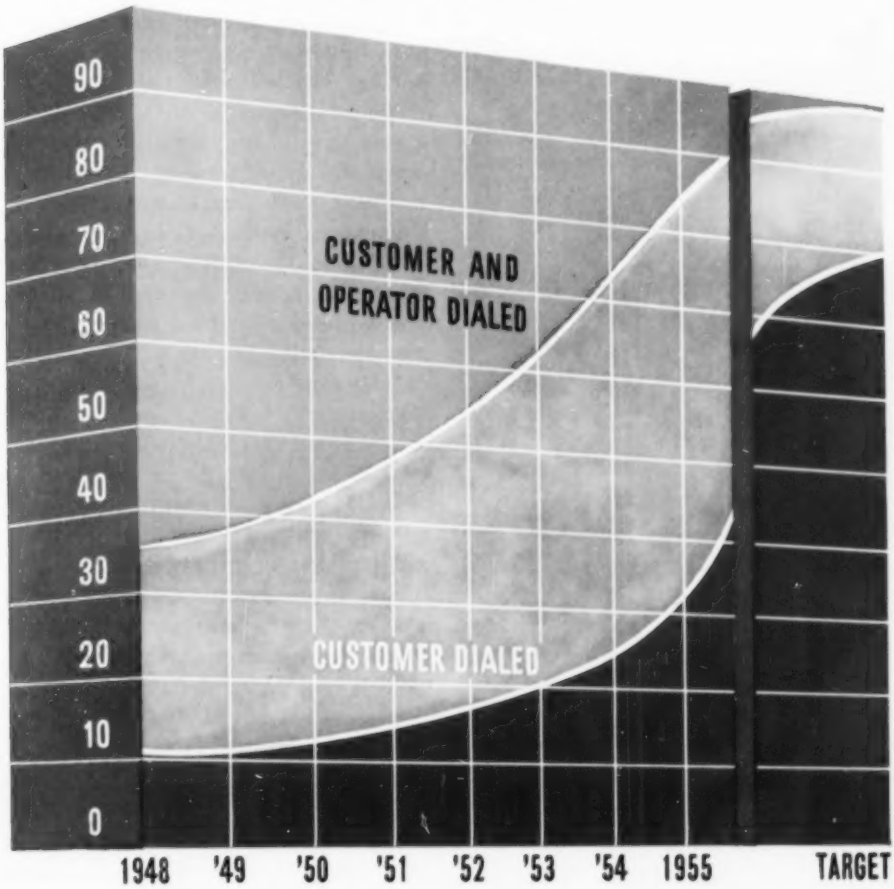


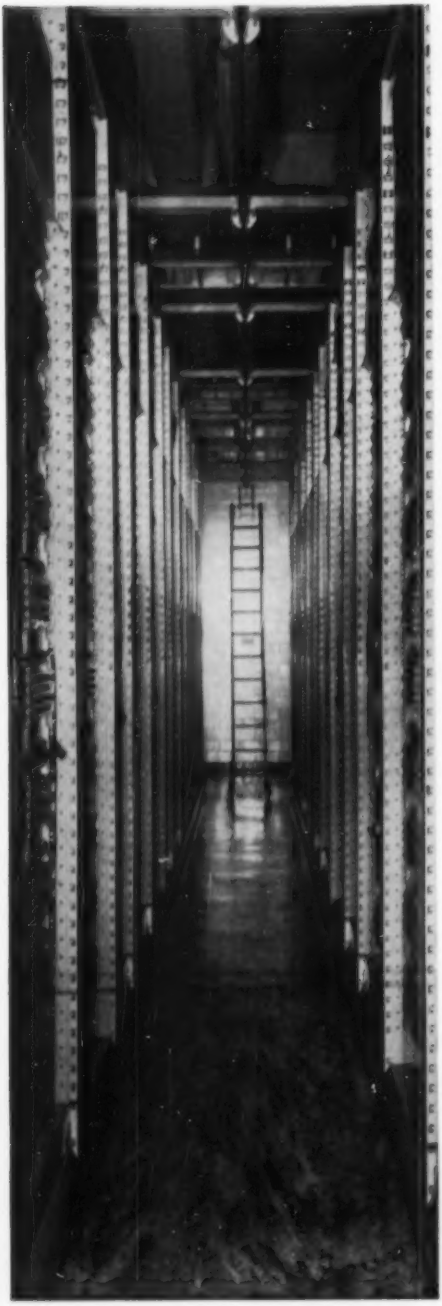
process the tapes from many AMA offices, and at the present time there are about 150 central offices using AMA, and 15 AMA accounting centers.

Subsequent modifications were made available for use in the No. 5 crossbar system which would permit customers to dial on a 10-digit nation-wide basis. This arrangement was first installed in Englewood, N. J., in 1951 as a trial, with customers dialing directly to about 11 million telephones in such places as San Francisco, Oakland, Boston, Philadelphia, Detroit, Cleveland, New York, and Pittsburgh.

This trial was so successful that the service was retained there, and has now been installed at some 30 other locations. In all of these locations, customers can now dial directly about 14 million telephones in 16 metropolitan areas from coast to coast, and about 25 more such locations will go in service this year. Although at present the

Estimate by years of the percentage of long distance and multi-unit messages dialed by operators and by customers.





Switching frames of a No. 5 crossbar system.

volume of 10-digit messages dialed is not large, this service is an important step toward the ultimate objective.

In addition to these places where 10-digit dialing will be started by the end of this year, there will be about 50 other locations which will be doing limited 10-digit dialing until arrangements are completed for them to use the nation-wide network.

CENTRALIZED AUTOMATIC MESSAGE ACCOUNTING. All of the recording systems mentioned so far are used in local central offices. It was realized that, because of insufficient traffic in some instances and certain limitations in others, the installation of these systems everywhere could not be justified. This led to the development of a system which used the AMA principles on a centralized basis. Here the recording equipment is installed at a centralized switching location and is arranged to serve a number of local offices in an area, thus distributing the cost of the recording equipment over a large number of stations. This is called centralized automatic message accounting (CAMA). The customer dials the number he wishes and an operator is momentarily brought in on the connection to request the calling subscriber's number and key it into the recording mechanism. This operator identification of the calling number is a temporary arrangement and development work is going ahead on automatic identification equipment so that it will not be necessary to bring in the operator. Other than this, the recording of the details of the call is automatic.

The first installation of this system was made in Washington, D. C., late in 1953. Since then CAMA systems have been placed in service in Detroit, San Francisco, Oakland, Philadelphia, New York, Jersey City, Morristown, and Newark, N. J., and

Cleveland and Pittsburgh. These installations in some cases supplement the use of zone registration. There are a number of CAMA installations to be made in the future. This system, used at present in the metropolitan areas, extends the dialing ranges of large numbers of customers and provides for direct dialing of large volumes of short-haul traffic.

At the present time the system is only applicable to panel-crossbar areas and in general is limited to 7-digit dialing by the capacity of the senders in the local office. A development is now almost completed which will expand the capacity of the local senders so that customers in these offices will be able to dial 10-digit calls on a nation-wide basis.

Also under development is a 10-digit CAMA system for use in step-by-step areas with crossbar tandem. The first installations will be made in Hartford, Conn., and South Bend, Ind., for service in the Summer of 1956. Nation-wide dialing will be possible with this system. However, in areas served by step-by-step dial offices the customer must dial an access code (112) before dialing either the 7-digit number to reach telephones in the home numbering-plan area or the 10-digit number to reach those in foreign areas. Exploratory studies are in progress to determine the best arrangements whereby ultimately the use of this 112 access code can be eliminated.

By the end of 1955, about 20 per cent of the main stations in the Bell System will have AMA or CAMA access. Our estimate is that this will reach 85 per cent by 1965.

Conclusion

WE HAVE MADE real progress during the past several years in the extension of the direct distance dialing program.

Today operators are dialing over half of the long distance and multi-unit calls. In some instances, however, the operator is using special routing codes instead of the proposed area codes, and also is completing calls to some offices not on a 2–5 numbering plan. Neither of these practices is practical for direct distance dialing by customers.

Customers are now dialing about 25 per cent of the long distance and multi-unit calls, but by far the greatest proportion of these are the short-haul multi-unit 7-digit calls. Of this 25 per cent which is being directly dialed, more than one-third are handled by Zone Registration equipment, 10 per cent by automatic ticketing, and the remaining 55 per cent by AMA and CAMA systems.

This over-all mechanization program is bringing about the integration of the local and long distance plant of the United States and Canada into one system comparable to that serving a metropolitan area.

In addition to the more important developments in the current picture which are essential to the direct distance dialing program, the need for others will arise in the future as the System strives to give better and better service. However, the program will not stand still during the development period. Instead, the Operating Companies' plans call for continuing progress in all of the major parts of the program: Local Mechanization, 2–5 Numbering, Automatic Message Accounting Facilities, and the implementation of the Automatic Long Distance Switching Plant. As now planned, the program will be spread over ten years or more. It requires continuous planning work and close intercompany and interdepartmental coördination. A major job indeed is still ahead; but the result will be a better, more convenient, more valuable, ***universal*** telephone service.

Their growth since the War parallels that of the Bell System, and augurs truly universal service through continued coöperation between the two groups

THE INDEPENDENTS TODAY

HARRY DISSTON

Independent Company Relations Engineer,
O. & E. DEPARTMENT, A. T. & T. COMPANY

In Falls River, Iowa, Claude Anderson owns a telephone company.* He is president. He is also general manager, chief engineer, general plant manager, general traffic manager, general commercial manager, and director of Public Relations. His company serves some 350 subscribers on 100 lines terminated in modern dial equipment in an attractive cement and brick building which is pointed to with pride by the local community.

Mr. Anderson owns a majority of the stock, but he has interested a number of his neighbors, business men in the town and farmers, in becoming share owners in the company. Funds loaned by his local bank and a large city bank helped materially in rebuilding and modernizing the plant and equipment (an up-to-date unattended dial office) and materially increasing the number of subscribers. Members of the local community have a good investment—both financially and service-wise.

Mr. Anderson's company is an "Independent." And what is an Independent company? Simply one that is not a Bell System company.

* Place and name are imaginary but representative.

The "Independent" Falls River company is in some ways typical. But there are smaller companies—some with as few as 100 subscribers. On the other hand, Independents serve such large cities as Rochester, N. Y.; Lincoln, Nebr.; Tampa, Fla.; Erie, Pa.; Fort Wayne and Terre Haute, Ind.; Durham, N. C.; Santa Monica and Long Beach, Cal. In addition to Lincoln, two other state capitals—Jefferson City, Mo., and Tallahassee, Fla., are served by Independent companies. In several instances a number of Independents are combined to form a "system." The largest of these at present comprises 16 operating telephone companies and serves nearly two million telephones.

It is truly remarkable that while nearly two million long distance calls a day are handled jointly by Independent companies and Bell System Companies, the customer feels that only one, "his" company, is taking care of his business—unaware that his message may involve facilities and operators of two or more separate companies, Independent and/or Bell. This is a great strength of the telephone industry.

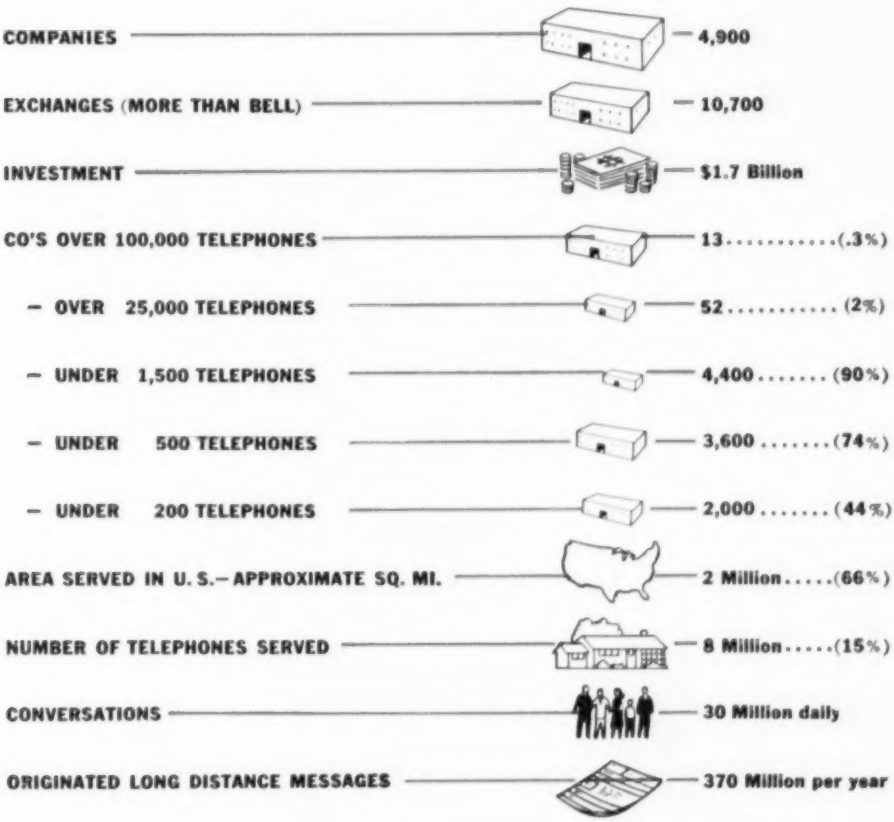
4,900 Independent Companies

WITHIN THE EXTREMES of the very small Independent, serving a rural area, and the large Independent, serving one of the leading cities, are some 4,900 separate and distinct Independent telephone companies. Almost 2,200 have fewer than 200 telephones, and nearly 3,600 have fewer than 500 telephones. Only about 500 have more than 1,500 telephones. Together, the 4,900 Independents serve approximately two-thirds of the geographical area of the United States. Most of this area has been rural—on the other hand, a good deal of population and industrial growth is expected in these sections.

The Independents operate about 8 million telephones—roughly 15 per cent of the telephones in the United States—through about 11,000 central offices. It is interesting that the Independent central offices exceed the number in the Bell System by about 1,500.

In volume of business, the Independents do a tremendous job. Some 30 million telephone conversations pass over their lines

THE INDEPENDENTS TODAY



daily, and they originate annually nearly 370 million toll messages—with a revenue value of about $240 million—which flow over both Independent and Bell System facilities to the telephones of Bell and Independent company subscribers. In turn, approximately an equal number of toll messages is originated by Bell customers to the telephones served by the Independents. Investment in Independent telephone company equipment and plant is in the order of 1.6 billion dollars, and the Independent companies employ perhaps ninety thousand people. The Independent segment of the industry is indeed important to this nation.

Growth among the Independents during the last ten years—paralleling growth in the Bell System—has been remarkable. Compared with ten years ago, the number of Independent telephones has almost doubled. During the same ten-year period, toll messages interchanged with Bell System companies increased 70 per cent and the revenue value of the messages even more—due to customers calling more distant points and talking longer, and to some extent due also to increases in rates. Investment in plant and equipment more than doubled, while the number of employees was half again as many as ten years ago; the number of customers served was nearly doubled also. Accompanying this substantial growth in items representing volume of service rendered there has, however, been a statistical decrease in two items—the *number* of Independent companies and of central offices.

Fewer But Stronger Companies

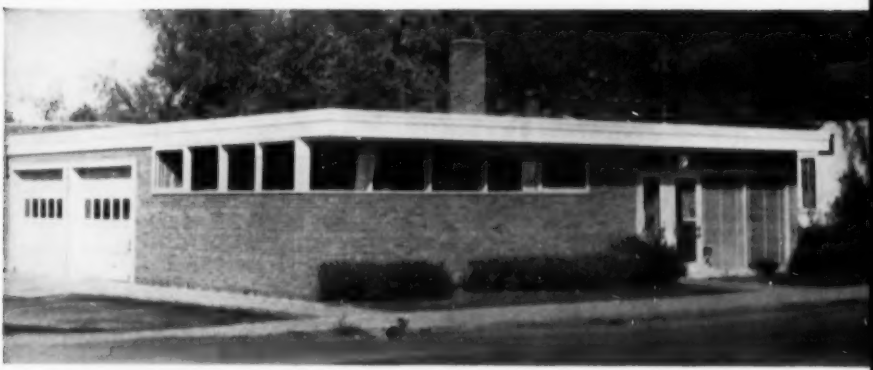
OVER THE TEN-YEAR PERIOD, the number of Independent companies decreased by about 1,300, from 6,200 to the present 4,900. So-called "farmer lines" or "switchers" are also decreasing. This reduction in the number of Independent companies has resulted largely from mergers of a number of small companies into larger Independents, with resultant economy and improvement in management, and the acquisition of small Independents by larger ones in the interest of economic integration of their properties. So, while there is now a smaller number of Independents than formerly, they are today stronger—financially, service-wise and management-wise. As a matter of fact, it is evident that telephone companies generally are expanding their thinking, equipment, plant, and operations to provide a modern, flexible, comprehensive service geared to the customers' changing and expanding requirements and utilizing the most modern techniques.

Today, about 60 per cent of the Independent telephones—and bear in mind that a large proportion are in rural and suburban areas—are dial. Along with this, the Independents generally are keeping pace with the modern trends in technology, operator and customer distance dialing, the use of carrier systems, radio relay (microwave) circuits, and like advances. Improvements in service include the most modern type of business office, coin telephone development and the installation of outdoor booths, extension and improvement of service in rural areas.

In modernizing and expanding their plant, equipment, and service in rural areas, a number of Independents, including mutuals and coöperatives, have received substantial aid from the Federal Government through the Rural Electrification Administration.

Independent Manufacturers Too

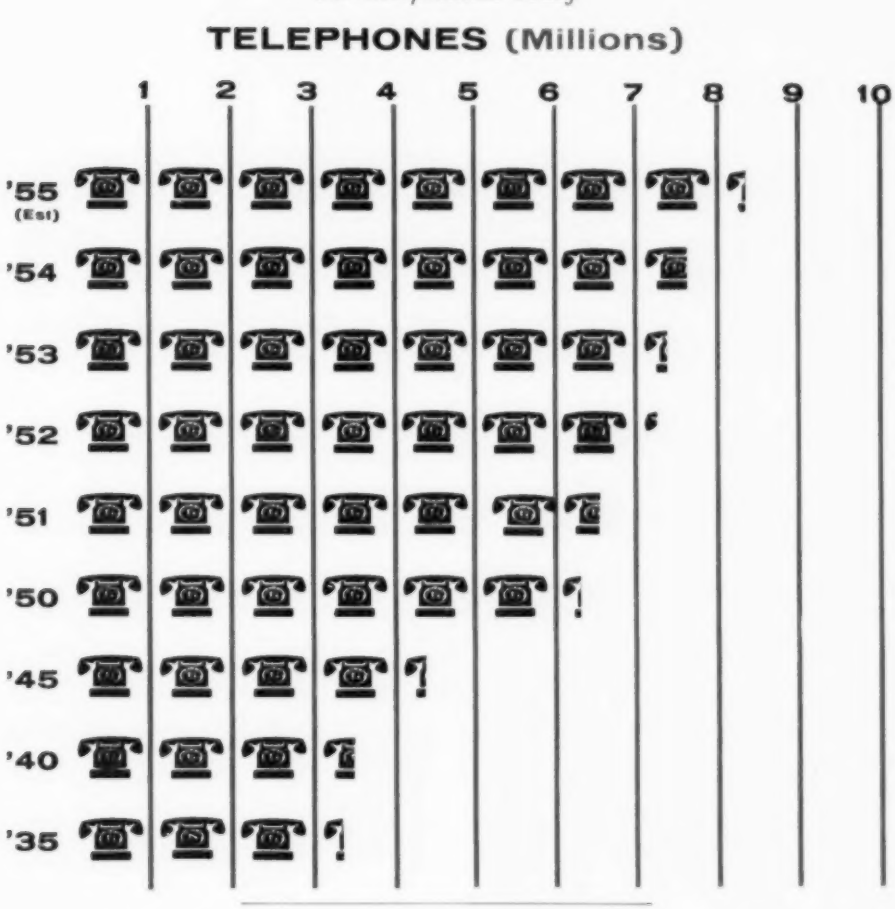
THE INDEPENDENT INDUSTRY is well equipped and supplied by five major and



Typical Independent company structures—including a headquarters building, a community dial office, and two which house both business and operating departments.

Traffic women meet for discussion of problems of mutual interest.

Above: A Plant Clinic learns the latest in splices.
Below: A spacious and well-equipped business office.



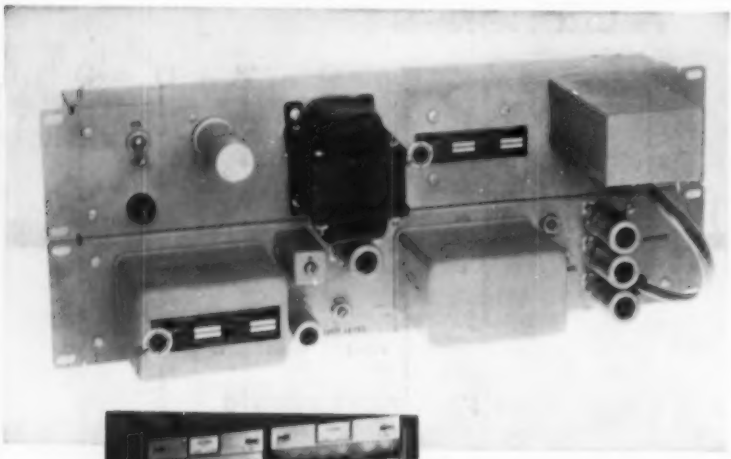
some 200 other Independent manufacturers and suppliers. They provide high grade modern products in everything from dial equipment, cables, and coin telephone booths to insulators, pliers, and stationery. Several companies specialize in providing a complete directory service. Others preserve poles and trim trees and there are several engineering and accounting consultants available to the Independent companies.

The industry is also served by a number of trade journals. Included among these are: the weekly *Telephony, Fortnightly Telephone Engineer, Telephone Engineer and Management,* and *Telecommunications Digest.*

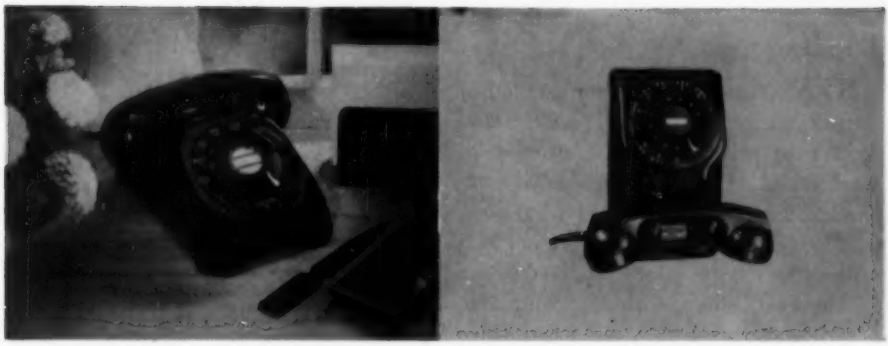
Associations

THERE ARE 34 ASSOCIATIONS of Independent telephone companies. Each generally includes all of the Independents in a state; however, in the Rocky Mountain area, eight states are included in the association, and Alabama and Mississippi have a joint association. All but six states are represented in some association.

These associations gather and dissem-



Modern equipment serves Independent company customers. Here are shown, from top to bottom, carrier system chassis, microwave radio bays, and dial equipment bays and power equipment.



Attractive telephones are produced by Independent manufacturers.

inate useful information and pamphlets, watch and report on legislation affecting the industry, frequently represent the Independent groups in contacts with state legislatures and regulatory bodies, provide assistance to small companies, and provide a group contact with the Bell System companies. Their annual conventions are important and popular affairs.

Representing the Independent industry as a whole is the United States Independent Telephone Association, with headquarters in Washington, D. C. About 80 per cent of the telephones of the Independent segment of the industry are operated by member companies of this important organization, which includes also the bulk of the Independent manufacturers. The association furthers and represents the common interests of the Independents; acts as their spokesman and represents them in contacts with the Federal Government and with the Bell System; provides a sounding board and clearing house for that segment of the industry; publishes statistics; and, in general, serves the industry on a national level in a manner similar to that in which the state associations serve their membership.

The several USITA committees concerned with matters of general interest to the Independent segment of the telephone industry are composed of public spirited Independent men from the small and the large companies. They serve for the benefit of all, without remuneration for this valuable service.

Intercommunication and Interrelation

AMONG THE FEATURES of the communication industry in our country—and no doubt contributing to its pre-eminence—is the very successful integration and interrelation of the many separate communications companies. Since it is important that the customer do not experience differences in the grade of service on the business handled jointly by different companies—sometimes several of them—it follows that Bell-Independent relations are of great importance. Bell relations with the Independents

A modern cordless PBX switchboard is another Independent product.

may be divided into three broad major categories:

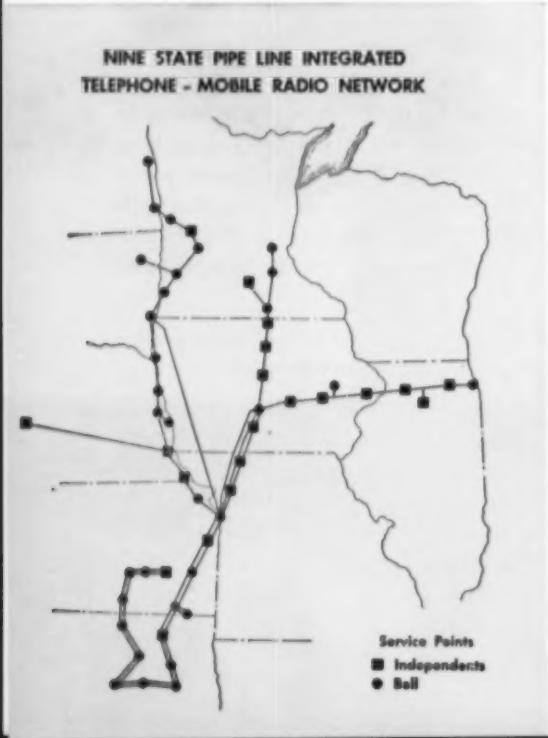
(1) *A mutually satisfactory division of responsibilities, ownership of facilities, and division of revenues received from joint business.* This involves a number of communications services; primarily, however, joint long distance business, short and long haul. Other services jointly rendered by the joint use of facilities include private line, teletypewriter exchange, radio and video networks; mobile service, extended area service, foreign exchange service; and the special requirements of railroads, pipe lines, and utility companies and the military;

(2) *Coöperation and assistance in furnishing, maintaining, and improving service on joint business and on facilities used jointly.* Such coöperation and assistance is a factor not only in the techniques, practices, and procedures of construction, maintenance, and operation, but also in long-range planning, cut-overs to dial, establishment of special services; in commercial, accounting, and rate matters; and in public relations. These activities involve also comprehensive assistance to the many smaller companies—including, frequently, the encouragement of mergers with other Independents to create a larger and more profitable operating unit. The joint use of the latest communication technique, microwave channels, poses some interesting and challenging problems.

(3) *Coöperation in extending service to rural and other areas not now adequately served.*

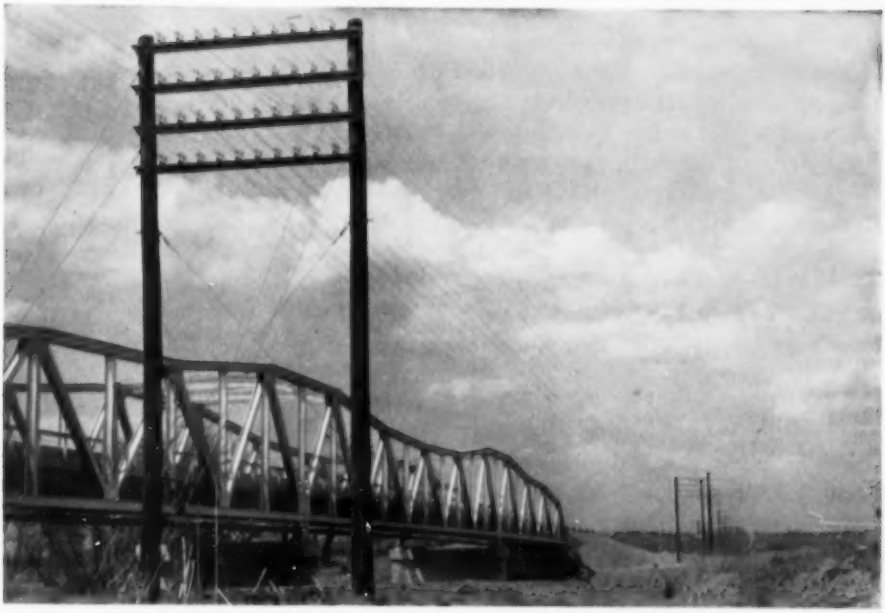
In each Associated Company of the Bell System, a small group of experienced specialists devote their entire time to matters concerning relations with the Independent companies, and coördinate interdepartmental contacts between Bell and Independent companies.

Providing service to pipe line companies is a joint undertaking.



Present-Day Problems

THE PROBLEMS of the Independents are, as one might expect, largely the same problems as the industry as a whole, and include such things as taking care of the continued huge demand for service, improving telephone development in rural areas, using the investment dollar where it will do the most good, obtaining adequate rates, financing, gaining public understanding and confidence, improving service, and attracting good career men. Other problems are the adoption of new techniques and increasing mechanization. An important and challenging problem, looking well into the future, is preparing for operator and customer direct dialing over longer and longer distances to the day when the customers of



A sturdy H-fixture open wire river crossing of an Independent Company.

most companies will be able themselves to dial any number, anywhere in the United States and Canada.

In the Independent industry, however, possibly the most pressing problem is the very small Independent. As previously mentioned, there are today roughly 3,600 telephone companies which operate less than 500 telephones each! To prosper, a telephone company, in this electronic age, must have full-time experienced management and high-grade modern equipment to provide a first rate, flexible, broad, modern communications service. Companies with less than 500 telephones frequently find difficulty in meeting the demands of their customers for a modern and complete service.

However, there are means to assist them, and many to provide such assistance: the Bell and larger Independent companies and the Independent associations. Most of the associations have special committees for this purpose. Local and some large city banks are prepared to provide short-term construction loans, while several insurance companies and the Rural Electrification Administration stand ready to make available long-term loans. Mergers with other Independents and integration of properties are, for many small companies, perhaps the most effective means of assuring profitable operations.

A little more about "assistance committees" may be of interest. Usually a special committee of each state telephone association is organized to head up the activity. The state committee in turn organizes regional or district committees to assist the smaller companies in several regional or district areas. In some cases, Bell companies, when requested, have participated in these activities. The committees' assistance involves, first, a survey of essential in-

formation concerning the smaller companies, covering such matters as management, ownership, rates, earnings, financing, plant and equipment, operating procedures, customer and public relations, territory served—and anything else that might affect the smaller company's operations from the standpoint of what is needed to assure a reasonably profitable going concern rendering satisfactory service to its customers and in a position to meet the demands made upon it for additional service.

The Future is Bright and Big

THE FUTURE for the Independents is bright—and big. It is reasonable to expect that the number of telephones operated by Independent companies, the number of long distance messages originated, and the revenues from these messages will increase in about the same manner as in the Bell System companies—especially due to the accelerated growth in the rural areas comprising the greater portion of the territory served by the Independents. The Independent companies individually will no doubt be larger and financially healthier. No doubt also they will have further mechanized their operations, broadened the scope of their service offerings, and received full recognition by the public of their existence and importance. And this healthy expansion of the Independents will present further fields of cooperation with the Bell System—and a stronger, healthier, still more progressive, flexible and dependable telephone industry in the United States.

Cable Pattern

Laying of the transatlantic telephone cable this Summer brings to mind the laying of the first transatlantic telegraph cable nearly a hundred years ago. As one consequence of the great interest in the earlier event, glass was manufactured in the United States in the 1860's in what was called the cable pattern. This compote is an example.

2500 sketches, measurements of 2000 faces, breadboard models, and lacquered sculptures were some of the steps which contributed to the present instrument

DESIGNING THE TELEPHONE

"We bear in mind that the object being worked on is going to be ridden in, sat upon, looked at, talked into, activated, operated, or in some other way used by people individually or en masse.

"When the point of contact between the product and the people becomes a point of friction, then the industrial designer has failed.

"On the other hand, if people are made safer, more comfortable, more eager to purchase, more efficient—or just plain happier—by contact with the product, then the designer has succeeded."

So writes industrial designer Henry Dreyfuss at the beginning of his new book "Designing for People." And when he speaks of the object being "talked into," he knows whereof he speaks—for he is the designer of the "500 set," so called (and what a pity his design couldn't have included a better name!). His account of how the telephone got its new look forms Chapter 7 of the book, and we are permitted to reprint it here—with some necessary deletions because of space limitations—through the courtesy of Mr. Dreyfuss and of his publisher, Simon and Schuster.* EDITOR.

OF ALL THE MAGIC of modern civilization, the telephone seems to me the most wondrous achievement. How easily we take for granted that the simple, commonplace spinning of a dial will enable us to talk privately and intimately with a particular person across a city or a continent or an ocean or on a speeding train or a ship at sea or in an auto or a plane several miles in the sky. We assume that the telephone will be there, within reach, in time of stress, to reassure one's family and friends or to transact business.

This assumption is not necessarily an expression of smugness or a feeling that our society is especially endowed, but rather a testimonial to the wonderful democracy of the telephone. It is available alike to millionaire and reliefer. It can be found in stock exchange and boudoir, in saloon and hospital. It has permeated our daily activity and become a personal thing, like reading a letter, and a habit, like brushing the teeth. A child uses it before he learns to read. People unhesitatingly call Washington, New York, Paris, or London.

Other scientific and engineering feats may be more spectacular—the Golden Gate bridge, the Mt. Palomar telescope, this country's fantastic radar screen, the supersonic jet bomber—but they are things apart. People do not live by them as they do by the ubiquitous telephone.

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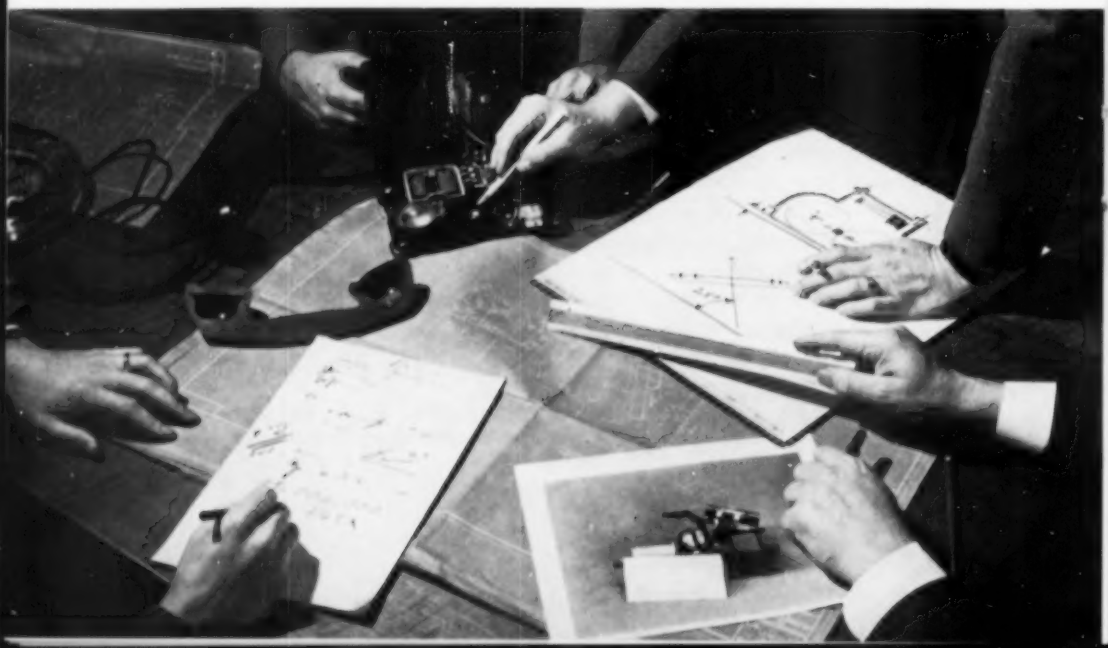
* Designing for People. Copyright 1955 by Henry Dreyfuss. Simon and Schuster, Inc., New York.

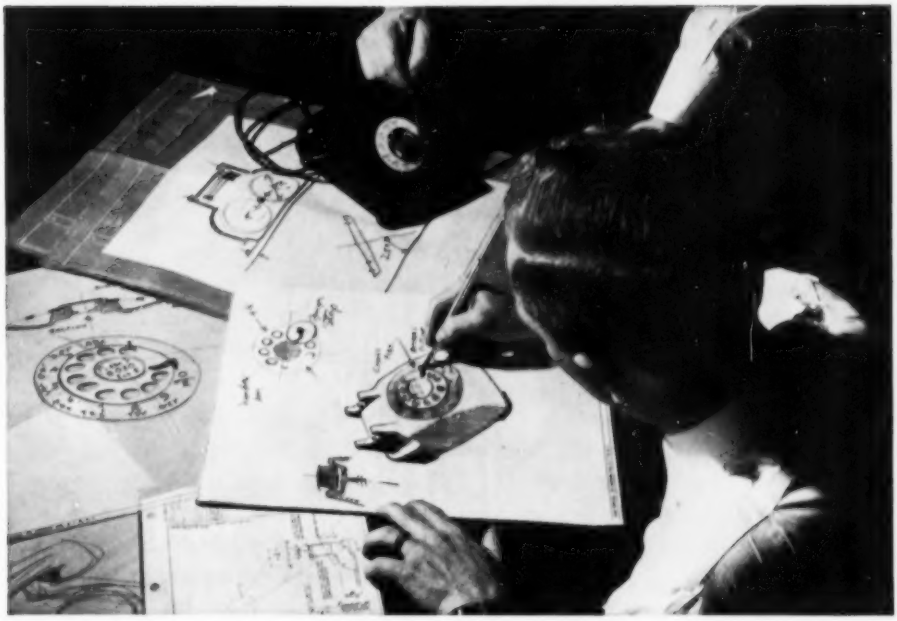
RECENTLY my plane was delayed for several hours by bad weather on a transcontinental trip, and as soon as it landed I rushed to a phone to relieve any anxiety my wife might have had. She calmly told me she knew the plane was going to be late. She had been on the telephone constantly, and the airline people had kept her informed of weather conditions and the progress of the plane. The incident recalled the "widow's walk" of New England. These were flat areas, with a railing, perched on the gabled roofs of old houses in fishing villages such as Nantucket. During storms, worried seafarers' wives paced these walks, looking out to sea for a glimpse of their husbands' ships returning to port. In a sense, the telephone is a kind of modern "widow's walk." A recent check disclosed that an average of 71,000 telephone inquiries about the weather are made daily in New York City. When storms threatened, the calls sometimes reached 270,000.

There are now more than 50,000,000 telephones in operation in the United States. Of this number, the Bell System provides service on 41,350,000. The rest are served by Independent operating companies substantially all of which have interconnecting facilities with the Bell System. The average subscriber makes 5.5 calls daily—a total of 275,000,000 calls every twenty-four hours. The average length of each conversation is 5.35 minutes, which means that Americans spend 1,471,000,000 minutes or 24,500,000 hours on the telephone every day. For a busy people, this certainly seems excessive. It is difficult to imagine that there can be that much of importance to talk about. Certainly, here is proof that Americans like to talk about little things as well as big things. Here also is an indication of the responsibility the telephone company feels in giving its subscribers an efficient telephone.

Before industrial design as we know it today was appreciated in most businesses, the telephone people had recognized that utility alone was not enough. In 1930, shortly after I opened my office, a representative of the Bell Telephone Laboratories called on me. He graciously dis-

This is what it's all about.





There has to be a basic design.

played no uneasiness over my office furniture—a borrowed card table and folding chairs—all I could afford at the time. His mission was to inform me that the Bell Laboratories were offering thousand-dollar awards to each of ten artists and craftsmen for their conceptions of the future appearance of the telephone.

It was flattering to be included in such a group, and the prospect of a thousand dollars was attractive. But I suggested that a telephone's appearance should be developed from the inside out, not merely created as a mold into which the engineers would eventually squeeze the mechanism, and this would require collaboration with Bell technicians. My visitor disagreed, saying such collaboration would only limit a designer's artistic scope.

Several months later he returned with a changed point of view. He admitted frankly that the telephones of the future submitted by the ten commissioned artists had been unsatisfactory. Some of them were quite original, he said, but all of them were impractical. Now he wanted to hear my ideas about design from the inside out. Our conversation led to an association that has proved eminently satisfying. No one could have been more co-operative than the Bell engineers have been through the years, or so patient and understanding.

TODAY THE CONVENIENCE of telephones is established, and they occupy the most accessible place in the home or office or store. Twenty-five years ago some people weren't quite sure where to put them. They were sometimes kept inside plaster globes of the world or cabinets or dolls with fluffy skirts. Because placement had a bearing on design, we had to determine what people

did with phones, and that is why the telephone company permitted me to act as a repairman's helper when he went on his rounds. My research ended abruptly when I went up in the service elevator of an apartment house and was ushered through the kitchen into the living quarters of a family I knew. There my hostess of a previous evening greeted me in some confusion and seemed surprised that a man who had represented himself as an industrial designer should be repairing telephones.

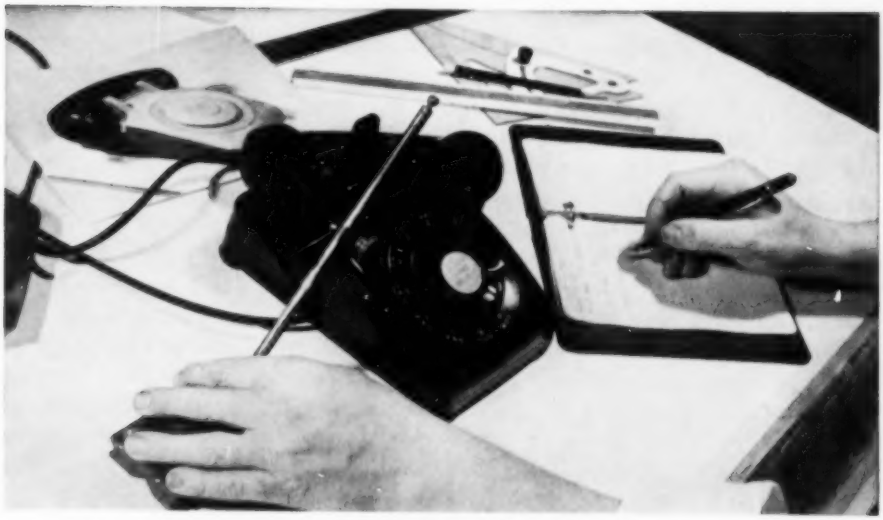
The telephone for which the Bell people were seeking a new appearance combined several features. After long development, the most serious operating faults of the so-called "French" phone or handset had been overcome. The resulting combination of a handset with parts of the old stand-up phone had produced the early cradle-type instrument. The proposed design, with smaller components housed within the instrument, would eliminate the box on the wall that held the ringing apparatus. In the final design, plastic was substituted for the metal housing. This is the type of phone in general use today.

Eight years ago the Bell people again began to discuss with us their ideas for another new telephone instrument. They wanted improved sound, volume, comfort, dial mechanism, new materials—in short, a new design. This was the beginning of what became the 500-Type Telephone Set —the instrument now being installed all over the country—and the start of another long collaboration between the Bell engineering staff and our office, involving a mountainous file of data and incalculable testing.

In seeking a new telephone appearance, the Bell people were confronted with a consideration in which the user was not primarily involved. The form had to be classic so that it would not be out of place with shorter-lived objects in homes and offices either at the time of introduction or twenty years later, the estimated life span of the instrument.

THIS IS A GOOD PLACE to point out that designing a telephone is not quite the same as designing a clock or a vacuum cleaner or a radio. In the accepted sense, there is no

A third dimension gives some idea of how it should look.



A model is checked for size.

consumer sales problem. Telephone subscribers do not buy their telephones; they use the instruments the Bell System makes available to them because telephones are part of the integrated over-all service that they purchase from the telephone company. Yet salesmanship of the highest order is still involved. The Bell System owes much of its growth to its acute awareness of public relations and its alertness to the subtleties in the relationship of men and machines. The telephone people want each piece of equipment to be an ambassador of good will. They know the subscriber will be pleased, perhaps subconsciously, when he finds the handset grip is more comfortable than the old model and that the voices of his friends are transmitted more clearly.

Toward this goal, we proceed slowly, discarding more innovations than we accept. We have to consider that phones are used not only on desks and tables while people are sitting, but also on counters and shelves for stand-up use. We have to give critical consideration to room lighting and to arm, wrist, and finger angles and motion in the dial operation.

Maintenance, always a factor in a new design, did not present too great a problem in the 500-Type set, as the maintenance record of the old instrument had been excellent. Nevertheless, to permit a greater degree of accessibility for repair, etc., Bell engineers fastened all components to the base plate. Previously, some of the components had been fastened inside the cover and others on the base plate.

The handset was re-engineered by the Bell people for better performance. Data in Bell files on the measurement of two thousand faces, to determine the average spacing between mouth and ear, were re-examined and interpreted in terms of a new instrument. Every conceivable kind of handgrip was considered—triangular in cross section like its predecessor, square, a thin rectangle, a thick rectangle, and many mongrel forms. The final selection

was the thick rectangle, slimmed down. In comparison with its predecessor, it was smaller, lighter, more comfortable, resisted turning in the hand, and looked better.

Drawing on years of experience with the dial number plate used on coin collectors in public telephone booths, Bell engineers expanded the existing three-inch dial of the desk telephone set to four and one quarter inches, the letters and numbers were placed outside the finger wheel, and the white characters were molded in black. (In the old dial, black letters and red numbers were printed on white under the wheel.) With the new placement, dragging fingers and pencils could no longer deface the characters, the flickering effect of the spinning wheel was eliminated, the characters could be made larger, the dial was easier to clean. Laboratory and field tests by typical telephone users under typical dialing conditions have pointed up these advantages.

Once Bell engineers established the basic position for the handset and dial, the phone began to fall into shape. This is an easy way of stating that something like 2500 rough sketches were scrutinized and narrowed down to half a dozen. Curiously enough, the first form conceived for the new combined set was generically the same as the form finally accepted.

IT WOULD SERVE no purpose to confound the reader with the infinite mass of statistical detail that had to be carefully studied, the suggested changes that were agreed upon, rejected, or modified, and the compromises effected between engineers and industrial designer. Inherent limitations dictated much of the design. The bell, for instance, had to be placed at the rear because, as the largest component, this was the only area available.

Our office was in turmoil for weeks over what was called the "ROH Battle"—receiver off hook. The telephone company has a pronounced distaste for hang-up errors—the subscriber should properly replace the handset on the cradle, so that the plunger buttons do not remain up, thus keeping the line closed and unavailable for subsequent calls—and lengthy discussions were held over whether two or four prongs on the cradle lessened this possibility.

Early designs of the new housing were unsatisfactory on two counts. They were too high, appearing taller than the old model, and the cradle prongs took away the sleek appearance that was desired. After renewed analysis, Bell engineers found that the housing could be lowered an important one eighth of an inch. Our contribution was optical. By making small changes in the shape of the housing, the position of the light reflection was changed, thus making the instrument *look* even lower.

Sketches were made of all these variations, then accurate layout drawings. These were followed by full-size "bread-board models" of the components. When several designs appeared likely, they were modeled in clay, which can easily be modified as ideas develop. Later they were cast in plaster, sculptured and lacquered. This high polish was important so that the model could be analyzed for light reflection that might prove annoying or tiring. Some were equipped with mock components such as handset dials, cords, and number plates to simulate the finished product. When all decisions were made, a bronze master was made of the final design. From this, the finished housing evolved, made of cellulose acetate butyrate.

The task has not ended there. The telephone family is a large one. Commercially,

Designer to clients—"How do you like it?"

not only telephone sets are involved, but also switchboard facilities and related installations. The new design also made allowance for special types of telephones—hard-of-hearing sets, four- and six-button sets, and two-line single-button sets, to permit interoffice communication and extended service. Some of these functions can be incorporated into the standard housing design, but special variations will require modifications.

In recognition of the increasing use of color in the decorative schemes of homes and offices, the 500 Set has been made available in a range of colors, although the familiar black will long be with us.

THE NEW TELEPHONE is already in many homes and offices, and the Bell people and our staff are very proud of it. It represents eight years of heartening and rewarding cooperation between Bell administrative, engineering, research, and sales personnel and our office. It is a tangible monument to integration. The lesson we all learned in contributing to a new and better telephone instrument was that not all parts of an old design need be changed for the sake of change, that some parts have proved themselves through years of use but that better devices, techniques, and materials may justify a change. One of these is the bell, which has a four-position volume-control wheel under the base plate, permitting users to select the bell volume they prefer.

It is inescapable that a sense of urgency be attached to a ringing telephone. It may be merely someone calling to accept an invitation to a birthday party, but it may also be an emergency that could affect lives. Perhaps it is wise to consider a telephone call in its proper perspective. It is relatively meaningless when a sixth-grade student calls a chum, and they do their homework jointly over the phone. But it may affect the future of the world when a president calls a prime minister.

HEADQUARTERS SUMMARY

March 15 to June 15, 1955

IT HAS BEEN the practice in flood areas to remove station equipment before the flood waters arrive and to replace it after the waters have receded, to prevent damage to the equipment. Some time ago, at the request of Ohio Bell, arrangements were made for the provision of a waterproof housing which could contain a standard station jack and withstand water pressure when submerged. The Ohio people felt that if a portable telephone was provided in each residence subjected to floods, the customer could remove the telephone and screw on the watertight cap of the housing. When the flood waters receded, he would reverse the procedure, restoring telephone service without awaiting the arrival of the Plant craftsman and equipment.

Approximately 2,000 of these watertight housings were installed by Ohio Bell in towns subjected to periodic floods. Last October over 300 of the housings were submerged by a flood. In all cases the customers removed their telephones (or moved them to temporary jacks in safe locations) during the flood period. In those cases where the jacks were submerged, no service reaction was experienced. Comments from the customers and Plant personnel in the areas affected were very favorable.

AS PART of the continuing study to improve the safety of telephone workers, a trial lot of nylon fluorescent flags has been made available which will provide a more effective warning to traffic at work locations along streets and highways than the present standard warning flags. These bright red flags have a somewhat shorter life, but they are more visible than the present standard flags even after fading and loss of fluorescence has occurred.

As another safety measure, a high visibility orange enamel—for touching up and painting construction apparatus and safety equipment—has been made available in self-pressurized spray cans. The light orange color was selected, with the cooperation of the safety engineers of some of the companies, as representing the best combination of high visibility and pleasing appearance.

WITH THE growth of nation-wide dialing, it is considered extremely important to be able to intercept calls to vacant central office codes and to disconnected, unassigned, or changed subscriber numbers, in preference to using tones or to the absence of any signal. To aid in meeting this objective, a new inexpensive system which gives a recorded answer to intercepted calls has been made available. It was developed for application in small dial offices, including all types of community dial offices.

THE PROCEDURES that have been in common use for determining ringing limitations over multi-party rural lines have tended to restrain the companies from pushing the sale of additional telephones or ringers for stations served by such lines. These procedures have been reviewed recently, with the result that some liberalizing of the ringing limitations has been proposed. The over-all effect of the new ringing ranges will be to permit a substantially increased number of additional telephones or ringers on multi-party lines.

IN ORDER for the plant engineer to foresee the need for additions to subscribers' cable plant, it is necessary to determine periodically the fills at each diminishing point along the cable route where congestion may occur, as well as at the central office. A simplified method of making these cable relief studies which can be readily carried out by clerical forces is described in a new section of engineering practices. The simplified procedures use microfilm copies of the cable assignment record in conjunction with standardized forms for summarizing and analyzing data.

MANY of the A. T. and T. Company's more than 1,375,000 share owners may have been surprised to find their July quarterly dividend checks in the mail box a few days earlier than expected. In the past, the dividend has been paid on or about the 15th of the first month of the calendar quarter. Now, through a rescheduling of dividend operations, the payment date for dividends has been advanced to the 10th of the month. However, since the 10th of this July fell on Sunday, the checks were mailed to reach share owners on the 11th.

The record date for dividends (the day on which a share owner's account must be in the Company's records in order for him to participate in the current dividend) has heretofore been the 15th of the last month of the

calendar quarter. Since the company wished to maintain the usual one-month interval between the record and payment dates in order to provide necessary working time for the preparation and mailing of the dividend, the record date also was advanced 5 days, so that for the recent dividend it fell on June 10.

THE A. T. and T. Company has leased the old Wanamaker store building, at Broadway and 10th Street in New York City, providing the Treasury Department with the space needed for handling the prospective new convertible debenture offer which was approved for not over $650 million by share owners at the April annual meeting. This will be the seventh convertible debenture offer in the post-war period, each of which has required a larger force to handle the work load as the family of A. T. & T. share owners has grown. The contemplated new offer will require a working force of about 1,500 people, including the force of the Rights Agent.

IT IS PLANNED to build two more stories on the four-story A. T. & T. building at 50 Varick Street in New York now occupied by the Stock and Bond Division of the Treasury Department and the Chief Statistician's Division of the Comptroller's Department, along with a small section of the General Service Department. The two additional stories will provide space for future special jobs, for additional Treasury facilities as needed, and for next year's Annual Meeting. The construction work will begin as soon as practicable after issue of the building permit, in order to reach completion on schedule.

A NEW COMPUTER, known as TRADIC (TRANsistor-DIgital-Computer), has been developed for the Air Force by Bell Telephone Laboratories. Using nearly 800 transistors, this device requires less than 100 watts to operate, as compared to early computers using as many as 18,000 electron tubes and frequently requiring thousands of watts to operate. Besides the transistors, this new electronic "brain" contains nearly 11,000 germanium diodes, which serve as the electronic equivalent of tiny one-way switches. TRADIC can operate flawlessly in planes flying at supersonic speed, and eliminates vacuum tube failure and heat, jet aircraft's greatest electronic problems.

WHEN THE Bell Solar Battery was first announced by Bell Telephone Laboratories, a year ago, Bell scientists had achieved a six per cent efficiency. Today, they have obtained experimentally eleven per cent—an efficiency comparable to that of the best gasoline engines and more than twenty times higher than that of the best photo-voltaic devices available.

HIGH-FREQUENCY PERFORMANCE of transistors has been greatly improved by several modifications of the basic n-p-n junction transistor. External dimensions have been decreased, the p-layer made very thin, and a fourth lead attached. The resulting tetrode transistor is expected to have important applications in high-frequency broadband transmission systems.

SUPPLIES AND MATERIALS from every state in the Union and 19 foreign countries were bought by Western Electric during 1954 for a total of $678,600,000 paid to 27,270 individual suppliers in 2,958 cities and towns. These purchases include raw materials and assemblies for manufacturing operations, supplies used directly by Western Electric, and supplies bought for use by Bell Telephone companies. New York State suppliers received a total of $105,976,000, the largest amount last year. California was second, Illinois third, New Jersey fourth and Pennsylvania fifth.

COMPLETION of Western Electric's newest manufacturing location has been announced. Located on a 62-acre site on Lexington Road, in Winston-Salem, N. C., the modern facility provides 625,000 square feet of floor space and employs 4,000 men and women. The new plant is in full manufacturing operation on communication devices for the Armed Forces and Bell telephone companies. It will serve also as headquarters for the North Carolina Works, which includes plants in Greensboro and Burlington.

A Chicago plant that Western Electric has leased since 1951 for the manufacture of military gun directors will soon be handling expanding production of dial central office equipment. The company has signed an additional five-year lease on the building, located on Fullerton Avenue, and will transfer military work being done there to the North Carolina Works.

The Blue Pencil

IF THIS ISSUE'S leading article seems unusually long—and it is, space-wise—that but reflects the magnitude and the significance of the enterprise it describes. With two continents and three countries involved, the ramifications —the items both great and small—which had to be kept in mind and in motion were beyond count. From the editorial standpoint, the normal requirements of checking for accuracy were multiplied both by the number of Bell System groups concerned and by the need for broad agreement on points of view. The manuscript was actually flown to England for consideration there—which might (but perhaps should not) be said to be carrying the pursuit of accuracy to great lengths. It's a splendid and dramatic yarn, withal, and not a tenth of it is told here. Perhaps another and final installment will be in order next year, after the second cable has been placed on the bottom and the service is operating.

OUR COVER PAINTING is motivated by the same topic, of course; but it should be well understood that it depicts the final moments of *a* submarine cable splice on *a* cable ship, and by no means a splice in *the* cable aboard the *Monarch*. It couldn't, obviously. It was painted for the MAGAZINE by George Samerjan, who also did the painting of the plaque of Alexander Graham Bell which was the frontispiece of last Winter's issue.

THE LAYING of the first transatlantic *telephone* cable this Summer inevitably brings to mind the laying of the first transatlantic *telegraph* cable. That event of 1858 created a furor which seems almost unbelievable 97 years later. *Frank Leslie's Illustrated Newspaper* of September 11 devoted an entire page of the minute type of that era to a listing of the events of September 1, beginning with services in Trinity Church at 10 A. M.; then a monster parade of 11 divisions of military and civilian organizations, estimated to include about 15,420 persons; and a reception for Cyrus W. Field, the cable's sponsor, in the Crystal Palace which was attended by "at least" 10,000 persons. A mammoth display of fireworks that evening set fire to City Hall and burned off the cupola, but that seemed not out of keeping with the general excitement of the day.

The reason for all this probably lay in the real importance of the cable. For at one stroke it linked England and the United States with the speed of electrical communication. No longer were news, people's messages, the world's business dependent on ships for transportation. The cable was an emotional as well as a physical tie that bound, and the celebration expressed what the people felt.

Unfortunately, it was all an enormous anticlimax, for transmission over the cable failed that very day. Field promoted another cable, which broke in mid-Atlantic, and, indomitable, a third, in 1866, which succeeded, and justified all the vision, the courage, the hope, and the money which went into the venture.

TODAY'S PROJECT has its roots in those past events, of course, and links with those earlier days are not lacking. Field sold what was left over from his first cable to Tiffany and Company, New York jewelers, and the latter cut it up and sold short pieces as souvenirs. These, with certificates of authenticity signed by Field, were immensely popular at the time, and some still exist in museums and probably in drawers and attics of old residences. Their current scarcity is attested by the year-and-a-half it took a Long Lines man to lay his hands on one. This same individual, RICHMOND B. WILLIAMS, who had much to do with the preparation of our cable article, also called attention to the cable pattern in glass made in the 1860's, indicative of the deep impression left upon this country by the event of nearly a century ago. We are indebted to him for the picture on page 128 of a compote created in that pattern.

AMID the myriad operations which keep our business running—whether they be the exciting task of conceiving and designing and laying a new kind of cable or the essential routines of billing our customers or ticketing their calls or installing welcome telephones for them —there ought to be time now and again for inspiration: a pause to enjoy a thrill of pride at some splendid accomplishment, or to get

a lift of the spirit from thoughts noble in themselves or nobly expressed. This publication deals in words, of course, and most of them are necessarily pretty matter-of-fact, so we find a special sense of satisfaction when we are able to bring to our readers words they may want to savor, to read twice and linger over and reflect upon, either because of the message they give us or the flavor and roundness with which they voice it.

Two items in this issue have for us that special sort of pleasure—as we hope they have for all our readers.

Mr. Price's guest editorial, complete in unity of thought and expressed in simple terms, tells with sincerity about the high principles which really do guide this business. Dr. Bush speaks of the broad aims which should direct men's lives in amity, but since his whole topic is communications, we telephone people may take his words to our hearts and cherish them. What appears on our back cover is but the last paragraph of his talk, which may be found in its entirety in *Mechanical Engineering* for April, 1955.

Another kind of essay which we have greatly enjoyed appeared in the issue of this MAGAZINE for Spring, 1950—more than five years ago. It was adapted then from a leaflet distributed to its employees by the New England Telephone and Telegraph Company, and we quote all of it, without changing 5-year-old figures—just because we like it:—

"WHAT IT MEANS TO BE TELEPHONE PEOPLE"

"We telephone people travel an unusual road.

"In a nation where big business and little business drive down a fast, competitive highway, we have been leased a private way. To us the people of the nation have singularly granted a trust and a power.

"In the Bell System there are more than half a million of us, serving twenty-five million customers. On our shoulders alone is the responsibility to give these people the round-the-clock, dependable telephone service they need. In our hands is a power to bind them together in friendship, trust, and common understanding.

"Over our switchboards go their hopes, their fears, their sorrows, their needs. Across our lines they order groceries from the corner store, close business deals, make appointments, send tidings of births and deaths. With our help they summon doctors when they're sick, policemen and firemen when they're in trouble. We have taken part in the shaping of the law, the progress of commerce, the growth of schools, and the courtship and marriage of two generations.

"Since the birth of the industry, telephone men and women have dedicated themselves to the fulfillment of this our public trust. They have developed within themselves and the telephone team a spirit of service and helpfulness that has surmounted fire, flood, and disaster. They have handed down to us a heritage rich with their courage, their loyalty, and their devotion in rendering a service to the people.

"We, the telephone people of today, are vested with the responsibility of carrying on this trust. We will make mistakes, for it is human to err. But in the long run, how we do our individual job, how we bear our individual responsibility, will determine how we achieve our trust. For in the last analysis we do not work for the telephone company. We are the telephone company."

Robert G. Elliott

Whos' Who & What's What

(Continued from page 71)

THE NEW YORK TELEPHONE COMPANY and 1921 were the place and time of HARRY DISSTON's start as a telephone man, and he was successively a district traffic superintendent, a district commercial manager, and a division commercial supervisor, before he transferred in 1932 to the commercial division of A. T. & T.'s O. and E. Department. Here for nine years he fulfilled various assignments in the commercial results section until he left for active military duty in the Pacific in 1941. Released as colonel in 1946, he returned to A. T. & T., and until 1951 he headed a group concerned with development, revenues, and commercial expense analysis. It was during this period that he contributed "Where Do We Go from Here?" to the Summer 1949 issue of this MAGAZINE. Since 1951 he has been in charge of the group handling Connecting Company matters.

Harry Disston

Our hope rests on the gradual spread of knowledge among men, and on the assumption that with knowledge will come true wisdom. In this hope we depend on the improvement of means of communication and the gradual disappearance of obstacles to their full employment. Thus the subject of our thinking is one of crucial importance. It is one on which the progress of civilization has always rested, and on which it will rest more heavily in the years to come. Any man who works to extend the power and versatility of methods and machines by which one man communicates with another, any man who struggles to bring new ways of communicating into uninhibited effect, can do so with a full conviction that he is laboring for the benefit of his fellow man.

From an address by Dr. Vannevar Bush, President of the Carnegie Institution of Washington and an A. T. & T. Director, at the 75th Anniversary meeting of the American Society of Mechanical Engineers in New York on Feb. 16, 1955. Published in Mechanical Engineering *for April 1955.*

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